









A KEY

TO THE

WESTERN CALCULATOR,

CONTAINING

THE SOLUTION OF ALL THE EXAMPLES AND
QUESTIONS FOR EXERCISE,

WITH REFERENCE TO THE PAGES WHERE THEY STAND.

TO WHICH IS ADDED,

SOME USEFUL RULES,

DESIGNED CHIEFLY TO FACILITATE THE LABOUR OF TEACHERS; AND
ASSIST SUCH AS HAVE NOT THE OPPORTUNITY OF A TUTOR'S AID.

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ARITHMETICAL MARKS AND SIGNS.

- $=$ The sign of equality, and is pronounced *equal*.
- $+$ The sign of addition, pronounced *added to*.
- $-$ The sign of subtraction, pronounced *subtracted by*.
- \times The sign of multiplication, pronounced *multiplied by*.
- \div The sign of division, pronounced *divided by*.
- $:::$ The sign of proportion, pronounced *is to, so is, to*.
- \varnothing Sign of difference, pronounced *the difference between*.
- $\sqrt{}$, or $\frac{1}{2}$, The sign of the square root.
- $\sqrt[3]{}$, or $\frac{1}{3}$, The sign of the cube root.
- 7^2 , Denotes that the number 7 is to be squared.
- 8^3 , Denotes that the number 8 is to be cubed.
- \therefore Or,
- Vinculum, and () parenthesis.

Examples.

- $12+7=19$; twelve added to 7 is equal to nineteen.
- $23-8=15$; twenty-three subtracted by eight, equal fifteen.
- $9\times 8=72$; nine multiplied into eight equal seventy-two.
- $24\div 3=8$; twenty-four divided by three equal eight.

Sometimes the division of one number by another, is expressed in the manner of a vulgar fraction; thus $\frac{27}{9}=3$, twenty-seven divided by nine equal three. Multiplication is also frequently denoted by this mark . thus $7.12=84$, seven into twelve equal eighty-four.

- $6:9::8:12$; as 6 is to 9 so is 8 to 12.
- $A\varnothing Z$; read the difference between A and Z.
- $\sqrt{81}=9$, or $81^{\frac{1}{2}}=9$; the square root of 81 equals 9.
- $10:100\therefore 1:10$; as 10 is to 100 that is as 1 is to 10.

A vinculum is placed over several quantities to denote that they are to be considered as one simple quantity; a parenthesis is often used for the same purpose.

KEY

TO THE

WESTERN CALCULATOR.



NUMERATION.

Page 8.

Example 1. 16 2. 49

Page 9.

3. 385 4. 2610 5. 64536 6. 253842

7. 5600006 8. 90000305 9. 829006002

1. Five.
2. Seventeen.
3. Thirty-five.
4. Four hundred and fifty-eight.
5. Six thousand, eight hundred and twenty-nine.
6. Seventy-two thousand, three hundred and forty-eight.
7. Three hundred and eighty-four thousand, seven hundred and twenty-one.
8. Two millions, six hundred and eighty-three thousand, two hundred.
9. Fifty millions, six hundred and seventy-eight thousand and twenty-four.

ADDITION.

Page 10.

- | | |
|--------------------|-------------------|
| 2. 1581366 | 3. 2468727092 |
| 4. 2284038452 | 5. 2263764650 |
| 6. 2968194198 | 7. 5831333360 |
| 8. 5075433465 | 9. 9750563355 |
| 10. 36447723180651 | 11. 3847099705067 |

Application.

Page 11.

1. 125	2. 129	dolls.	barrels	dolls.
23	654	3. A 125	4. 60 for	480
16	8070	B 286	75	675
2060	10000	C 29	220	2200
8009574	4000000	D 672	126	1386
6				
<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>
8011804	4018853	\$ 1112	481 bbls.	4741 dolls.

5. 297	6. 1209	7. 1811	dolls.
125	476	21	
754	8017	<u> </u>	8. George 3560
127	3119221	1832	William 3240
245	<u> </u>		Samuel 2850
<u> </u>	3128923		Henry 2555
1548			Thomas 2226
			<u> </u>
			14431

SUBTRACTION.

Page 12.

3. 44064062638	4. 5390534442
5. 56053355680	6. 00000001

Application.

1. 1818	2. 5648	barrels
1777	3460	3. 1260
<u> </u>	<u> </u>	
41	2188	sells to A 320
		B 435
		<u> </u>
		sold in all 755
		<u> </u>
		unsold 505
4. 6000	cents	cents
600	5. 145	35 penknife
<u> </u>	75	25 slate
5400	40	64 paper
	<u> </u>	30 apples
	given him 260	<u> </u>
	given away 154	154
	<u> </u>	
	left 106	

MULTIPLICATION.

Case 1. Page 13.

$$\begin{array}{r} 2. \quad 24639576 \\ \quad \quad 4 \\ \hline 93558304 \end{array}$$

$$\begin{array}{r} 3. \quad 3675432568 \\ \quad \quad \quad 8 \\ \hline 29403460544 \end{array}$$

Page 14.

$$\begin{array}{r} 5. \quad 476824753 \\ \quad \quad 5 \\ \hline 2384123765 \end{array}$$

$$\begin{array}{r} 6. \quad 964703024 \\ \quad \quad 6 \\ \hline 5788218144 \end{array}$$

$$\begin{array}{r} 7. \quad 74020005 \\ \quad \quad 8 \\ \hline 592160040 \end{array}$$

$$\begin{array}{r} 8. \quad 2901946808 \\ \quad \quad 9 \\ \hline 26117521272 \end{array}$$

$$\begin{array}{r} 9. \quad 246354276 \\ \quad \quad 11 \\ \hline 2709897036 \end{array}$$

Case 2.

$$\begin{array}{r} 2. \quad \text{Mult. } 68523047653 \\ \quad \text{by } 2367 \end{array}$$

$$\begin{array}{r} 479661333571 \\ 411138285918 \\ 205569142959 \\ 137046095306 \\ \hline 162194053794651 \end{array}$$

Page 15.

$$\begin{array}{r} 3. \quad \text{Mult. } 5221 \\ \quad \text{by } 145 \\ \hline 26105 \\ 20884 \\ 5221 \\ \hline 757045 \end{array}$$

$$\begin{array}{r} 4. \quad \text{Mult. } 23430 \\ \quad \text{by } 230 \\ \hline 702900 \\ 4686 \\ \hline 5383900 \end{array}$$

$$\begin{array}{r} 5. \quad \text{Mult. } 3800920 \\ \quad \text{by } 80750 \\ \hline 190046000 \\ 2660644 \\ 30407360 \\ \hline 306924290000 \end{array}$$

$$\begin{array}{r} 6. \quad \text{Mult. } 89536925 \\ \quad \text{by } 735 \\ \hline 447684625 \\ 268610775 \\ 626758475 \\ \hline 65809639875 \end{array}$$

$$\begin{array}{r} 7. \quad \text{Mult. } 78965987 \\ \quad \text{by } 5893 \\ \hline 236897961 \\ 710693883 \\ 631727896 \\ 394829935 \\ \hline 465346561391 \end{array}$$

$$\begin{array}{r} 8. \quad 1.15 \\ \quad 75 \\ \hline 575 \\ 805 \\ \hline \$86.25 \end{array}$$

$$\begin{array}{r} 9. \quad 3950 \\ \quad 29 \\ \hline 35550 \\ 7900 \\ \hline \end{array}$$

$$\begin{array}{r} 10. \quad 40 \\ \quad 12 \\ \hline 480 \text{ pence} \end{array}$$

\$1145,50

Case 3. Page 15.

$$\begin{array}{r}
 2. \text{ Mult. } 871075 \\
 \text{by } 21 \quad \quad 3 \\
 \hline
 2613225 \\
 \quad \quad 7 \\
 \hline
 18292575
 \end{array}$$

$$\begin{array}{r}
 3. \text{ Mult. } 2453642 \\
 \text{by } 36 \quad \quad 6 \\
 \hline
 14721852 \\
 \quad \quad 6 \\
 \hline
 88331112
 \end{array}$$

$$\begin{array}{r}
 4. \text{ Mult. } 43102 \\
 \text{by } 64 \quad \quad 8 \\
 \hline
 344816 \\
 \quad \quad 8 \\
 \hline
 2758528
 \end{array}$$

$$\begin{array}{r}
 5. \text{ Mult. } 23645 \text{ by } 144 \\
 \quad \quad 12 \\
 \hline
 283740 \\
 \quad \quad 12 \\
 \hline
 3404880
 \end{array}$$

$$\begin{array}{r}
 6. \text{ Mult. } 12071 \text{ by } 99 \\
 \quad \quad 9 \\
 \hline
 108639 \\
 \quad \quad 11 \\
 \hline
 1195029
 \end{array}$$

Case 4. Page 16.

$$\begin{array}{r}
 2. \text{ Mult. } 3600 \\
 \text{by } 400 \\
 \hline
 1440000
 \end{array}$$

$$\begin{array}{r}
 3. \text{ Mult. } 44000 \\
 \text{by } 550000 \\
 \hline
 220 \\
 220 \\
 \hline
 24200000000
 \end{array}$$

$$\begin{array}{r}
 4. \text{ Mult. } 663000 \\
 \text{by } 60000 \\
 \hline
 39780000000
 \end{array}$$

NOTE. *Ex.* 1. $200 \times 10 = 2000$
 2. $462 \times 100 = 46200$
 3. $879 \times 1000 = 879000$

Application.

$$\begin{array}{r}
 1. \quad 15 \\
 \quad 25 \\
 \hline
 \quad 75 \\
 \quad 30 \\
 \hline
 \text{dolls. } 375
 \end{array}$$

$$\begin{array}{r}
 2. \quad 125 \\
 \quad 43 \\
 \hline
 \quad 375 \\
 \quad 500 \\
 \hline
 \text{dolls. } 53,75
 \end{array}$$

$$\begin{array}{r}
 3. \quad 32 \text{ cents} \\
 \quad 440 \\
 \hline
 \quad 1280 \\
 \quad 128 \\
 \hline
 \text{dolls. } 140,80
 \end{array}$$

4. $60 \times 125 = 75,00$ wheat	5. 100	6. 32
$40 \times 85 = 34,00$ rye	10	sub. $20 \times 24 = 480$
$34 \times 50 = 17,00$ corn	<hr/>	<hr/>
	1000 dimes	$12 \times 18 = 216$
<hr/>	10	<hr/>
\$ 126,00 amount	<hr/>	panes 696
	10000 cents	

Page 17.

8. 7525	8. dolls. 250 A's	\$ 250 A
125	3	750 B
<hr/>	<hr/>	3000 C
37625	750 B's	
15050	4	
7525	<hr/>	4000 altogether
<hr/>	3000 C's	
940625		

DIVISION.

Case 1.

3. 4)4756394344	4. 5)97036142	5. 8)37846210
<hr/>	<hr/>	<hr/>
1189098586	19407228 $\frac{2}{5}$	4730776 $\frac{2}{8}$
6. 12)64381259	7. 6)3824966	8. 7)46825486
<hr/>	<hr/>	<hr/>
5365104 $\frac{11}{12}$	637494 $\frac{2}{6}$	6689355 $\frac{1}{7}$
	9. 9)8297463813	
	<hr/>	
	921940423 $\frac{6}{9}$	

Case 2. Page 18.

divisor	dividend	quot.	4. 735)47989536925(65291886 quotient
3. 64)	29687624	463869	4410 735
256	64		<hr/>
408	1855476		3889 326459435*
384	2783214		3675 195875659
<hr/>	<hr/>		<hr/>
247	29687616		2145 457043209
192	8 rem.		<hr/>
<hr/>	<hr/>		1470 47989536925 proof
556	29687624 proef		<hr/>
512			6753 6615
<hr/>	<hr/>		<hr/>
442			1386 6392
384			735 5880
<hr/>	<hr/>		<hr/>
584			6519 5880
576			<hr/>
<hr/>	<hr/>		6392 5880
8 rem.			<hr/>
			5125 4410
			<hr/>
			715 rem.

*Add in the remainder as you multiply when working the proof.

5. 2359)4917968967 (2084768
4718 2359

<u>19996</u>	<u>18762917</u>
18872	10423845
	<u>6254306</u>
<u>11248</u>	<u>4169537</u>
9436	
	4917968967 proof
<u>18129</u>	
16513	

16166
14154

20127
18872

1255 rem.

6. 671)5374608 (8009
5368 671

<u>6608</u>	<u>8018</u>
6039	56069
	<u>48059</u>
<u>569</u>	<u>5374608</u>

7. 175296) 19842712000 (113195
175296 175296

<u>231311</u>	<u>679170</u>
175296	1018763
	<u>226392</u>
<u>560152</u>	<u>565976</u>
525888	792373
	<u>113195</u>

342640
175296 19842712000

1673440
1577664

957760
876480
81280

8. 108) 5704392 (52818
540 108

<u>304</u>	<u>422552</u>
216	528184
	<u>5704392</u>
<u>883</u>	
864	

199
108

912
864
48

Case 4. Page 19.

2. 6|00)876|54

146 54 rem.

3. 8|0)2834|7

354 27 rem.

4. 16|00)1370|00(85
128

90
80
1000 rem.

NOTE.

2. 1|00)256|54

or 256 quot. 54 rem.

3. 1|000)876|029

or 876 quot. 29 rem.

4. 1|0000)80|0000

or 80 quot.

Application.

1. 855)4275(5 boys
4275

Page 20.

$$\begin{array}{r} 2. \quad 28 \overline{)2072(74} \\ \underline{196} \end{array}$$

$$\begin{array}{r} 112 \\ 112 \\ \hline \end{array}$$

$$\begin{array}{r} 3. \quad 75 \overline{)45000(600} \\ \underline{450} \\ 00 \end{array}$$

$$\begin{array}{r} 4. \quad 8164 \\ \quad \quad 10 \text{ subtract} \\ \hline 27 \overline{)8154(302} \\ \underline{81} \\ 54 \\ 54 \end{array}$$

5. Here begin with the 150 and work backwards.

thus $5 \overline{)150}$

$$\begin{array}{r} \underline{30} \\ 12 \text{ subtract} \\ \underline{\quad} \\ 2 \overline{)18} \\ \underline{\quad} \\ 9 \text{ Ans.} \end{array}$$

6. 13440 dollars

$$\begin{array}{l} \frac{1}{4} = 3360 \text{ eldest son's share} \\ \frac{1}{5} = 2688 \text{ 2d son's} \quad " \\ \frac{1}{6} = 2240 \text{ 3d son's} \quad " \\ \frac{1}{7} = 1920 \text{ 4th son's} \quad " \\ \frac{1}{8} = 1680 \text{ 5th son's} \quad " \end{array}$$

11888 sum of 5 shares

then 13440

11888 subtract

1552 6th son's share

$$\begin{array}{r} 7. \quad 72034 \overline{)5190048(72} \\ \underline{504588} \\ 144168 \\ 144168 \end{array}$$

8. Because A has 10 cents per day more than B, and B 10 cents per day more than C, it is evident that A will get in all 8 dollars more than C, and B 4 dollars more than C, which together is 12 dollars.
then from 228
take 12

Divide by the number of persons $3 \overline{)216}$

72 C's share
consequently 76 B's share
and 80 A's share

$$\begin{array}{r} 9. \quad \text{half Eagle} \quad 500 \\ \quad \text{half a dollar} \quad 50 \\ \quad \text{quarter dollar} \quad 25 \\ \hline \end{array}$$

575 cents

$$\begin{array}{r} 575 \overline{)1437,50(250} \\ \underline{1150} \\ 2875 \\ 2875 \end{array}$$

$$\begin{array}{r} 10. \quad \text{Captain} \quad 6 \text{ shares} \\ \quad \text{Mate} \quad 4 \quad " \\ \quad \text{Seamen} \quad 40 \quad " \\ \hline \text{No. of shares} \quad 50 \end{array}$$

Then $5 \overline{)0}455 \overline{)0}$

dolls. 91 one seaman's sh.

Now $91 \times 6 = 546$ Capt. share

And $91 \times 4 = 364$ mate's share

FEDERAL MONEY.

ADDITION. Page 22.

2. Dolls. 19320,43 3. Dolls. 204588,00½

SUBTRACTION.

2. Dolls. 325216,94½ 3. Dolls. 126723,53¾

MULTIPLICATION. Page 23.

2. Dolls. 15823,50 3. Dolls. 57408,79½

DIVISION.

2. Dolls. 726,55 3. Dolls. 10343,79½

PROMISCUOUS QUESTIONS.

	<i>E d d c m</i>	<i>Dolls.</i>
<i>Quest. 1.</i>	25,0,0,0,0	2. 1055 in notes
	6,2,0,0,0	260 gold
	8,0,0	3650 silver
	7,5,5	250 cents
	<u>31,3,5,5,5</u>	\$ 4967,50

Or, \$ 313 55½ cts.

3. Sugar	\$ 39,87½	4. From	\$ 645,95½
Coffee	22,18¾	Take	350,00
Tea	2,12½		<u>\$ 295,65½</u>
	<u>\$ 64,18¾</u>		

5. Lent \$ 1000,00

6. \$ 102,19

Received at { 160,25
sundry pay'ts. { 285,66½
 { 300,28¾

Mult. by 120
\$ 12262,80

Received in all \$ 746,20½

7. Dolls. 4,50
16

Unpaid \$ 253,79¾

\$ 72,00

8. \$ 17,37½
132
3474
5211
173766
\$ 2293,50

9. 5)6022,50
\$ 1204,50

Page 23.

$$\begin{array}{r}
 10. \quad 18)252.90(14.05 \\
 \underline{18} \\
 72 \\
 \underline{72} \\
 90
 \end{array}$$

$$\begin{array}{r}
 11. \quad 45)22.50(50 \text{ cts.} \\
 \underline{225} \\
 0
 \end{array}$$

Page 24.

$$12. \quad 25)15555,50(622\text{d. } 22\text{c.}$$

COMPOUND ADDITION.

ENGLISH MONEY. Page 25.

$$2. \quad \text{£}136739 \text{ } 6 \text{ } 3\frac{1}{2}$$

$$3. \quad \text{£}15725 \text{ } 11 \text{ } 11\frac{1}{2}$$

TROY WEIGHT.

$$2. \quad \begin{array}{cccc} \text{lb.} & \text{oz.} & \text{dwt.} & \text{gr.} \\ 22 & 7 & 6 & 6 \end{array}$$

$$3. \quad \begin{array}{cccc} \text{lb.} & \text{oz.} & \text{dwt.} & \text{gr.} \\ 33 & 0 & 9 & 19 \end{array}$$

AVOIRDUPOIS WEIGHT. Page 26.

$$1. \quad \begin{array}{cccccc} \text{T.} & \text{cwt.} & \text{qr.} & \text{lb.} & \text{oz.} & \text{dr.} \\ 128 & 12 & 1 & 18 & 14 & 10 \end{array}$$

$$2. \quad \begin{array}{cccccc} \text{T.} & \text{cwt.} & \text{qr.} & \text{lb.} & \text{oz.} & \text{dr.} \\ 2921 & 3 & 0 & 9 & 0 & 8 \end{array}$$

APOTHECARIES' WEIGHT.

$$1. \quad \begin{array}{ccccc} \text{lb.} & \text{oz.} & \text{dr.} & \text{sc.} & \text{gr.} \\ 24 & 4 & 5 & 2 & 16 \end{array}$$

$$2. \quad \begin{array}{ccccc} \text{lb.} & \text{oz.} & \text{dr.} & \text{sc.} & \text{gr.} \\ 220 & 2 & 0 & 2 & 10 \end{array}$$

CLOTH MEASURE.

$$1. \quad \begin{array}{ccc} \text{Yds.} & \text{qr.} & \text{na.} \\ 215 & 2 & 0 \end{array}$$

$$2. \quad \begin{array}{ccc} \text{E. Fl.} & \text{qr.} & \text{na.} \\ 173 & 0 & 0 \end{array}$$

$$3. \quad \begin{array}{ccc} \text{E. Fr.} & \text{qr.} & \text{na.} \\ 128 & 4 & 0 \end{array}$$

$$4. \quad \begin{array}{ccc} \text{E. En.} & \text{qr.} & \text{na.} \\ 221 & 0 & 2 \end{array}$$

LONG MEASURE. Page 27.

$$1. \quad \begin{array}{cccccc} \text{deg.} & \text{m.} & \text{fur.} & \text{po.} & \text{yd.} & \text{ft.} & \text{in.} & \text{bc.} \\ 207 & 27 & 5 & 6 & 1 & 0 & 4 & 0 \end{array}$$

$$2. \quad \begin{array}{cccc} \text{L. M.} & \text{fur.} & \text{yds.} & \text{ft.} & \text{in.} \\ 13 & 2 & 3 & 167 & 2 & 10 \end{array}$$

LAND MEASURE. Page 28.

$$1. \quad \begin{array}{ccc} \text{A.} & \text{R.} & \text{P.} \\ 161 & 1 & 29 \end{array}$$

$$2. \quad \begin{array}{ccc} \text{A.} & \text{R.} & \text{P.} \\ 2134 & 2 & 23 \end{array}$$

$$3. \quad \begin{array}{ccc} \text{A.} & \text{R.} & \text{P.} \\ 1999 & 2 & 32 \end{array}$$

CUBIC, OR SOLID MEASURE.

$$1. \quad \begin{array}{ccc} \text{Co. ft.} & \text{in.} & \\ 26 & 4 & 1407 \end{array}$$

$$2. \quad \begin{array}{ccc} \text{T.} & \text{ft.} & \text{in.} \\ 21 & 16 & 1542 \end{array}$$

$$3. \quad \begin{array}{ccc} \text{T.} & \text{ft.} & \text{in.} \\ 271 & 26 & 1294 \end{array}$$

TIME. Page 29.

	Y.	mo.	d.	h.	mi.	sec.		Y.	d.	h.	mi.	sec.
1.	104	2	26	13	23	27	2.	14	240	4	4	33

MOTION.

	sig.	deg.	mi.	sec.		sig.	°	'	"
1.	9	16	9	17	2.	10	12	45	23

LIQUID MEASURE. Page 30.

	T.	hhd.	gal.	qt.	pt.		T.	hhd.	gal.
1.	20	0	15	3	1	2.	79	0	11

DRY MEASURE.

	bu.	P.	qt.		bu.	P.	qt.		bu.	P.	qt.
1.	175	2	3		2.	1553	3	4	3.	41920	0 7

COMPOUND SUBTRACTION.

Page 31.

	T.	cwt.	qr.	lb.	oz.	dr.		mi.	fur.	P.	ft.	in.	bc.
2.	156	19	0	22	2	6	3.	124	5	34	4	7	2

	bu.	P.	qt.	pt.		D.	h.	mi.	sec.
4.	53	3	4	1	5.	88	21	44	34

	T.	hhd.	gal.	qt.	pt.		sig.	deg.	mi.	sec.		A.	R.	P.
6.	29	2	47	3	1	7.	2	22	15	41	8.	408	2	22

Promiscuous Questions in Compound Addition and Subtraction.

Quest.	No.	1,	yds.	qr.	na.		£.	s.	d.
1.	1,	36	3	2	2.	1st.	6	2	4
	"	2,	45	1	3	2d.	5	10	9½
	"	3,	48	2	1	3d.	7	0	0
	"	4,	52	0	3	4th.	8	10	6
	"	5,	64	2	0	5th.	9	2	6
			yards	247	2	1			
							£36	6	1½ cost
							Received	£22	10 6
							Note	£13	15 7½

Page 32.

	<i>lb.</i>	<i>oz.</i>	<i>dwt.</i>	<i>gr.</i>		<i>lb.</i>	<i>oz.</i>	<i>dr.</i>	<i>sc.</i>	<i>gr.</i>
Quest. 3. Bought	26	9	10	0	4. Bought	6	10	6	2	0
Wrought up	18	0	16	10	Used	4	5	4	1	17

Has left 8 8 13 14

lb. 2 5 2 0 3

	<i> yrs.</i>	<i> mo.</i>	<i> day.</i>	<i> hr.</i>	
5. Charles born	1817	3	20	9 evening	
William born	1816	1	15	6 morning	

Year 1 2 5 15

	<i>Cwt.</i>	<i>qr.</i>	<i>lb.</i>
6. 1st.	18	2	14
2d.	16	3	18
3d.	22	0	24
4th.	24	1	0

	<i>yds.</i>
7. sold to A	5½
B	6¼
C	7¾
	20½

Cwt. 82 0 0

yds. 40 sold and left.

Or, 4 Ton, 2 cwt.

Then from *yds.* 55
take 40

yds. 15 for D and E.

But because E has half as much as D, and together have 15; therefore D has 10, and E has 5.

	<i>gals.</i>
8. bought 1 pipe	= 126
2 hhds.	= 126
3 quarter casks	{ 26
	{ 26
	{ 26

	<i>gals.</i>
sold 1 hhd.	63
2 qr. casks	52
leaked { pipe	17
	{ hhd. 11
	{ cask 5½

330 bought
148½ sold and leaked

gallons 148½

181½ left.

	<i>E.</i>	<i>Fr.</i>	<i>qr.</i>	<i>na.</i>	<i>yds.</i>	<i>qr.</i>	<i>na.</i>
9. Bought	{ 9	3	2=14	1	2		
two first	{ 9	3	2=14	1	2		
two last	{ 8	2	3=12	2	3		
	{ 8	2	3=12	2	3		

yards 54 0 2
40 2 0

13 2 2 yards left.

COMPOUND MULTIPLICATION.

Case 1. Page 33.

2.	T. cwt. qr. lb. oz. dr.	3.	lb. oz. dwt. gr.
146	2 3 44 6 1	71	10 17 7
4.	bu. pc. qt.	5.	hhd. gal. qt. pt.
199	3 0	283	33 2 1
6.	deg. mi. fur. p.		
		67	18 6 32
7.	yds. ft. in. bc.	8.	A. R. P.
149	1 4 0	809	0 34
		9.	bu. pc. qt.
		538	1 2
10.	d. h. mi. sec.	11.	yrs. m. w. d.
763	8 44 15	1508	2 2 6

Application.

Quest. 1.	£. s. d.	2.	£. s. d.
	2 6 4		1 2 6½
	5		9
	£11 11 8		£10 2 8¼
3.	£. s. d.	4.	£. s. d.
	0 12 9½		2 4 2½
	11		12
	£7 0 8½		£26 10 6

Case 2. Page 34.

Application.

1.	T. cwt. qr. lb. oz. dr.		
4	3 1 16 8 10	by 36	
		6	
25	0 1 15 3 12	product by 6	
		6	
150	2 1 7 6 8	product by 36	
2.	£. s. d.	3.	T. cwt. qr. lb.
Mult. 120	6 9 by 24	Mult. 24	4 2 7 by 48
	6		12
	722 0 6		290 14 3 0
	4		pro. by 12
	2888 2 0		4
	product by 24		1162 19 0 0
			pro. by 48

Case 3. Page 34.

		<i>d.</i>	<i>h.</i>	<i>mi.</i>	<i>sec.</i>	
2.	Mult.	8	4	12	5	by 29
					4	

32 16 48 20 product by 4
7

$$\begin{array}{ccccccc} 228 & 21 & 38 & 20 & \text{product by} & 28 & \\ 8 & 4 & 12 & 5 & \text{"} & 1 & \end{array}$$

days 237 1 50 25 product by 29

Case 4. Page 35.

	<i>s.</i>	<i>d.</i>
2.	14	6
		10

$$\begin{array}{r} 7 \quad 5 \quad 0 \times 4 \\ 10 \end{array}$$

72 10 0
2

145	0	0	value of 200
29	0	0	' of 40

£174 0 0 value of 240

3. £. s. d.
 1 2 3 × 7
 10

$$\begin{array}{r} 11 \quad 2 \quad 6 \times 1 \\ 10 \end{array}$$

111	5	0	val.	of	100
11	2	6	'	'	10
7	15	9	'	'	7

£130 3 3 val. of 117

	£.	s.	d.
4.	1	2	6 × 5
			10

$$\begin{array}{r} 11 \quad 5 \quad 0 \times 7 \\ 10 \end{array}$$

112 10 0
2

225	0	0	value	of	200
78	15	0	'	of	70
5	12	6	'	of	5

£309 7 6 value of 275
2*

COMPOUND DIVISION.

Case 1. Page 36.

2. Ans. $\begin{array}{r} \text{£.} \\ 187 \end{array}$ $\begin{array}{r} \text{s.} \\ 18 \end{array}$ $\begin{array}{r} \text{d.} \\ 5\frac{1}{2} \end{array}$ 3. Ans. $\begin{array}{r} \text{T. cwt. qr. lb.} \\ 15 \quad 6 \quad 0 \quad 7 \end{array}$
4. Ans. $\begin{array}{r} \text{yds.} \\ 192 \end{array}$ $\begin{array}{r} \text{ft.} \\ 0 \end{array}$ $\begin{array}{r} \text{in.} \\ 4\frac{1}{5} \end{array}$ 5. Ans. $\begin{array}{r} \text{T. hhd. gal. qt.} \\ 58 \quad 2 \quad 13 \quad 3\frac{7}{8} \end{array}$
6. Ans. $\begin{array}{r} \text{w. d. h. mi. sec.} \\ 3 \quad 0 \quad 16 \quad 16 \quad 53 \end{array}$

Case 2.

2. $\begin{array}{r} \text{£.} \\ 11 \overline{)134} \end{array}$ $\begin{array}{r} \text{s.} \\ 18 \end{array}$ $\begin{array}{r} \text{d.} \\ 8 \end{array}$ 3. $\begin{array}{r} \text{£.} \\ 12 \overline{)984} \end{array}$ $\begin{array}{r} \text{s.} \\ 0 \end{array}$ $\begin{array}{r} \text{d.} \\ 0 \end{array}$
- 4) 12 5 4 quot. by 11 12) 82 0 0 by 12
- $\begin{array}{r} \text{£3} \quad 1 \quad 4 \end{array}$ ' by 44 $\begin{array}{r} \text{£6} \quad 16 \quad 8 \end{array}$ by 144
4. $\begin{array}{r} \text{£.} \\ 12 \overline{)474} \end{array}$ $\begin{array}{r} \text{s.} \\ 0 \end{array}$ $\begin{array}{r} \text{d.} \\ 0 \end{array}$
- 6) 39 10 0 quotient by 1
- $\begin{array}{r} \text{£6} \quad 11 \quad 8 \end{array}$ ' by 7

Case 3. Page 37.

2. $\begin{array}{r} \text{£.} \\ 345 \overline{)409} \end{array}$ $\begin{array}{r} \text{s.} \\ 13 \end{array}$ $\begin{array}{r} \text{d.} \\ 9 \end{array}$ ($\begin{array}{r} \text{£.} \\ 1 \end{array}$ $\begin{array}{r} \text{s.} \\ 3 \end{array}$ $\begin{array}{r} \text{d.} \\ 9 \end{array}$ 3. $\begin{array}{r} \text{£.} \\ 232 \end{array}$ $\begin{array}{r} \text{s.} \\ 4 \end{array}$ $\begin{array}{r} \text{d.} \\ 9 \end{array}$
- $\begin{array}{r} 345 \\ \hline 64 \\ 20 \end{array}$ $\begin{array}{r} 20 \\ \hline \text{s.} \\ 524 \overline{)4644} \end{array}$ $\begin{array}{r} \text{d.} \\ 8 \end{array}$ $\begin{array}{r} 10\frac{1248}{524} \end{array}$
- $\begin{array}{r} 345 \overline{)1293} \end{array}$ (3s. $\begin{array}{r} 1035 \\ \hline 258 \\ 12 \end{array}$ $\begin{array}{r} 4192 \\ \hline 452 \\ 12 \end{array}$
- $\begin{array}{r} 345 \overline{)3105} \end{array}$ (9d. $\begin{array}{r} 3105 \end{array}$ $\begin{array}{r} 524 \overline{)5433} \end{array}$ (10d. $\begin{array}{r} 524 \\ \hline 193 \\ 4 \end{array}$
- $\begin{array}{r} 524 \overline{)772} \end{array}$ (1qr. $\begin{array}{r} 524 \\ \hline 243 \text{ rem.} \end{array}$

$$\begin{array}{r} \text{£. s. d.} \\ 4. \quad 654)3236 \quad 12 \quad 4\frac{1}{2} \quad (\quad 4 \quad 18 \quad 11\frac{3}{4} \\ \underline{2616} \end{array}$$

$$\begin{array}{r} 620 \\ 20 \end{array}$$

$$\begin{array}{r} 654)12412(18s. \\ \underline{654} \end{array}$$

$$\begin{array}{r} 5872 \\ 5232 \end{array}$$

$$\begin{array}{r} 640 \\ 12 \end{array}$$

$$\begin{array}{r} 654)7684(11d. \\ \underline{654} \end{array}$$

$$\begin{array}{r} 1144 \\ 654 \end{array}$$

$$\begin{array}{r} 490 \\ 4 \end{array}$$

$$\begin{array}{r} 654)1962(3qr. \\ \underline{1962} \end{array}$$

$$\begin{array}{r} \text{£. s. d.} \\ 5. \quad 68)132 \quad 0 \quad 8 \quad (\quad 1 \quad 18 \quad 10 \\ \underline{68} \end{array}$$

$$\begin{array}{r} 64 \\ 20 \end{array}$$

$$\begin{array}{r} 68)1280(18s. \\ \underline{68} \end{array}$$

$$\begin{array}{r} 600 \\ 544 \end{array}$$

$$\begin{array}{r} 56 \\ 12 \end{array}$$

$$\begin{array}{r} 68)680(10d. \\ \underline{68} \end{array}$$

$$0$$

Promiscuous Questions for Exercise in Compound Addition, Subtraction, Multiplication and Division.

$$\begin{array}{r} \text{s. d.} \\ \text{Quest. 1.} \quad 2 \quad 5 \times 2 \\ \quad \quad \quad 10 \end{array}$$

$$\begin{array}{r} 1 \quad 4 \quad 2 \times 7 \\ \quad \quad \quad 10 \end{array}$$

$$\begin{array}{r} 12 \quad 1 \quad 8 \\ \quad \quad \quad 6 \end{array}$$

$$\begin{array}{r} 72 \quad 10 \quad 0 \text{ value of 600 yards} \\ 8 \quad 9 \quad 2 \quad \text{' of 70 ' } \\ 4 \quad 10 \quad \text{' of 2 ' } \end{array}$$

$$\text{£}81 \quad 4 \quad 0 \text{ value of 672 yards}$$

$$\begin{array}{r} \text{T. cwt. gr. lb.} \\ 3. \quad 1 \quad 2 \quad 3 \quad 16 \\ \text{Mult. by} \quad \quad \quad 8 \text{ loads} \\ \hline 9 \quad 3 \quad 0 \quad 16 \end{array}$$

$$\begin{array}{r} \text{lb. oz. dwt. gr.} \\ 2. \quad 4 \quad 1 \quad 15 \quad 22 \\ \quad \quad \quad \quad \quad 11 \text{ ingots} \end{array}$$

$$\begin{array}{r} 45 \quad 7 \quad 15 \quad 2 \end{array}$$

$$\begin{array}{r} \text{T. cwt. gr. lb.} \\ 4. \quad 8 \quad) \quad 9 \quad 3 \quad 0 \quad 16 \\ \hline 1 \quad 2 \quad 3 \quad 16 \text{ one share} \end{array}$$

Page 37.

	A.	R.	P.
5.	300	2	20
			5
<hr/>			
	1503	0	20
			3
<hr/>			
	4509	1	20

Page 38.

	A.	R.	P.		bu.	d.	c.	d.	c.	m.
6.	5)4509	1	20	7.	179) 201	37½	(1	12	5
						179		or 1	doll.	12½c.
	<hr/>					<hr/>				
	3)901	3	20			223				
						179				
	<hr/>					<hr/>				
	300	2	20			447				
						358				
						<hr/>				
						895				
						895				

	d.				bushels.
8.	7×5			9.	1000
	10			Mult. by	10½ cts.
	<hr/>				<hr/>
	5	10×6			10000
		10			500
	<hr/>				<hr/>
	2	18	4		\$105,00
			3'		

8	15	0	in 300 days
1	15	0	‘ 60 ‘
2	11	‘	5 ‘
<hr/>			
£10 12 11 in 365 days			

	bu.	d.	c.	d.	c.		£.	s.	d.
10.	135×2	05	=276	75		11.	3)47	12	10½
	135×1	62½	=219	37½	prime cost		9)15	17	7½
							<hr/>		
					\$57 37½ gain		£1	15	3½

Page 38.

<p>12. <i>dolls.</i> 9708 2</p> <hr/> <p>5)19416</p> <hr/> <p>3883 20 eldest son.</p> <hr/> <p>3)5824 80 rem.</p> <hr/> <p>\$ 1941 60 other sons, each</p>	<p>13. <i>dwt. gr.</i> 17 8 9</p> <hr/> <p>7 16 0 wt. of 9 dolls. 5</p> <hr/> <p>oz. 39 0 0 wt. of 45 dolls.</p>
--	--

<p>14. <i>oz. dwt. gr.</i> 84 7 20 20</p> <hr/> <p>150)1687 (<i>dwt. gr. gr.</i> 150 11 6+8 over 11 6 standard</p> <hr/> <p>187 0 0+8 grains over 150</p> <hr/> <p>37 24</p> <hr/> <p>148 76</p> <hr/> <p>150)908(6 900</p> <hr/> <p>8 grains</p>	<p>15. <i>cwt. lb.</i> 2½=280 Mult. by 133 mills</p> <hr/> <p>\$37,24</p>
--	---

16.	35 × 20 dolls. notes = 700 dolls.	
	63 Eagles	= 630
	284 dollars	= 284
	642 half dollars	= 321
	368 qr. dollars	= 92
	256 × 12½ cents	= 32
	Deposited Dolls.	2059
	Checks 560 + 820 =	1380
	Dolls.	679

Page 38.

$$\begin{array}{rcl}
 & \text{dolls. cts.} & \text{dolls. cts.} \\
 17. & 36 \text{ yds. at } 4 & 66 = 167,76 \text{ cost} \\
 & & \text{Add } 29,56 \text{ gained}
 \end{array}$$

Must sell all for \$197,32

$$\begin{array}{rcl}
 & \text{dolls. cts.} & \text{d. c.} \\
 & 4 \text{ yds. at } 2 & 33 = 9,32 \\
 & 8 \text{ yds. at } 5 & 50 = 44,00
 \end{array}$$

12 yds. is sold for \$53,32

$$\begin{array}{rcl}
 & & \text{dolls. cts.} \\
 \text{Now, from } 36 \text{ yds. which must sell for} & & 197 \ 32 \\
 \text{Take } 12 \text{ yds. which brought} & & 53 \ 32
 \end{array}$$

The diff. 24 yds. must sell for \$144 00

yds. dolls.
 But 24) 144 (6 dollars.

$$\begin{array}{rcl}
 & \text{cts.} & \text{d.} & \text{cts.} \\
 18. & 12\frac{1}{2} \times 5 = 0 & 62\frac{1}{2} \text{ beds.} \\
 & 62\frac{1}{2} \times 4 = 2 & 50 \text{ supper and breakfast} \\
 & & 75 \text{ for liquor} \\
 & 25 \times 5 = 1 & 25 \text{ for hay}
 \end{array}$$

\$5 12½

From 6 dollars take \$5,12½, and the remainder
 is 87½ cts. = 875 mills.

cts. ms.

But 2½ = 25) 875 (35 qts. = 8¾ galls.
 And 6 dollars ÷ 5 travellers = \$1,20 = 120 cents.

Page 39.

$$\begin{array}{rcl}
 & \text{h. m.} & \text{h. m. minutes} \\
 19. & 12 \ 25 \times \text{by } 5 = 62 & 5 = 3725 \\
 & 11 \ 30 \times \text{by } 9 = 103 & 30 = 6210
 \end{array}$$

[Sum 9935 minutes

Now 9935 minutes
 Mult. by 75 cents per day

49675
 69545

h. m. *dolls. cts. ms.*
 8 = 480) 745125 (15 52 3 +

Page 39

$$\begin{array}{r} \text{gal.} \quad \text{qt.} \quad \text{pt.} \\ 20. \quad 5)1534 \quad 1 \quad 1 \end{array}$$

$$\begin{array}{r} 5)306 \quad 3 \quad 1 \end{array}$$

$$\text{galls.} \quad 61 \quad 1 \quad 1$$

$$22. \quad \text{A} \quad 1$$

$$\text{B} \quad 2$$

$$\text{C} \quad 6$$

$$-$$

$$9$$

$$21. \quad \begin{array}{r} h. \quad mi. \\ 9)114 \quad 45 \end{array}$$

$$\begin{array}{r} 12h \quad 45min. \end{array}$$

$$\text{dolls.}$$

$$9)180$$

$$20 \quad \text{A's share}$$

$$20 \times 2 = 40 \quad \text{B's}$$

$$40 \times 3 = 120 \quad \text{C's}$$

REDUCTION.

MONEY. Page 41.

$$4. \quad 4)120506 \text{ farthings}$$

$$12) \quad 30126 \quad \frac{1}{2}$$

$$2|0) \quad 251|0 \quad 6\frac{1}{2}$$

$$\text{£}125 \quad 10 \quad 6\frac{1}{2}$$

$$5. \quad 10)260 \text{ cents}$$

$$26 \text{ subtract}$$

$$234 \text{ pence}$$

Page 42.

$$6. \quad \begin{array}{r} \text{£.} \quad \text{s.} \quad \text{d.} \\ 480 \quad 19 \quad 9 \end{array}$$

$$20$$

$$9619$$

$$12$$

$$9)115437 \text{ pence}$$

$$12826\frac{1}{2} \text{ add}$$

$$128263\frac{1}{2} \text{ cents}$$

$$7. \quad 12)4658$$

$$2|0) \quad 38|8 \quad 2$$

$$\text{£}19 \quad 8 \quad 2$$

$$8. \quad 9)648 \text{ pence}$$

$$72 \text{ add}$$

$$720 \text{ cents}$$

$$9. \quad \begin{array}{r} 720 \text{ cents} \\ \frac{1}{10} = 72 \text{ subtract} \end{array}$$

$$648 \text{ pence}$$

$$10. \quad 2)24235 \text{ half pence}$$

$$12)12117\frac{1}{2}$$

$$2|0)100|9 \quad 9\frac{1}{2}$$

$$l. \quad 50 \quad 9 \quad 9\frac{1}{2}$$

11. 216 French crowns
Mult. 99 pence in a crown

1944

1944

12)21384 pence

2|0) 178|2

89l. 2s.

13. 375l.
8

3)3000

\$1000

12. £. s.
29 17

20

597

12

7164

$\frac{1}{9} = 796$ add

7960 cents

Or, 79 dolls. 60 cents.

TROY WEIGHT.

1. 24 { (4)115200 grains
(6)28800
2|0) 480|0 pennyweights
12)240 ounces
lb. 20

2. 30 pounds
12

360 oz.

20

7200 dwts.

24

172800 gr.

3. 2|0)4564|8 dwts.
2282oz. 8dwt.

4. lb. oz. dwt. gr.
4 8 15 20

12

56 ounces

20

1135 dwts.

24

4540

2272

27260 grains.

5. 24 { (4)27260 grains
(6) 6815

2|0)113|5 20

12) 56 15 20

4lb. 8oz. 15dwt. 20gr.

Page 42.

	<i>dwt.</i>	<i>gr.</i>
6.	8	6
	24	
	<hr/>	
	198	gr.
	24	spoons
	<hr/>	
	792	
	396	
	<hr/>	
	4752	grains

AVOIRDUPOIS WEIGHT.

1.	3 tons	2.	(4) 2867200 drams
	20		16 { <hr/>
	<hr/>		(4) 716800
	60 cwt.		<hr/>
	4		16 { (4) 179200 oz.
	<hr/>		(4) 44800
	240 qr.		<hr/>
	28		28) 11200 lb.
	<hr/>		<hr/>
	1920		4) 400 qr.
	480		<hr/>
	<hr/>		2 0) 10 0 cwt.
	6720 lb.		<hr/>
			5 tons.

3.	<i>Tons.</i>
	5
	20
	<hr/>
	100
	4
	<hr/>
	400 gr.
	28
	<hr/>
	11200 lb.
	16
	<hr/>
	179200 oz.
	16
	<hr/>
	2867200 dr.

4.	<i>cwt.</i>	<i>qr.</i>
	1	3
	4	
	-	
	7	
	28	
	<hr/>	
	196	lbs.
	Mult.	6 barrels
	<hr/>	
	1176	lbs.

Page 42.

	<i>cwt.</i>	<i>qr.</i>	<i>lb.</i>
5.	16	2	14
	4		
	—		
	66		
	28		
	—		
	532		
	133		
	—		
	1862		lb.

	<i>lb.</i>
6.	28)2876
	—
	4) 102 20
	—
	25 <i>cwt.</i> 2 <i>qr.</i> 20 <i>lb.</i>

APOTHECARIES' WEIGHT.

	<i>lb.</i>
1.	15
	12
	—
	180 <i>oz.</i>
	8
	—
	1440 <i>dr.</i>
	3
	—
	4320 <i>scr.</i>

Page 43.

	<i>lb.</i>
2.	3
	12
	—
	36 <i>oz.</i>
	8
	—
	288 <i>dr.</i>
	3
	—
	864 <i>scr.</i>
	20
	—
	17280 <i>gr.</i>

	<i>lb.</i>
3.	24
	12
	—
	30
	8
	—
	16)240 <i>drams</i>
	—
	15 <i>parcels</i>

4.	2)057600 0 <i>grains</i>
	—
	3)28800 <i>sc.</i>
	—
	8) 9600 <i>dr.</i>
	—
	12)1200 <i>oz.</i>
	—
	100 <i>lb.</i>

CLOTH MEASURE. Page 43.

$$\begin{array}{r} 1. \quad 250 \text{ yards} \\ \quad 4 \\ \hline \end{array}$$

$$\begin{array}{r} 1000 \text{ qrs.} \\ \quad 4 \\ \hline \end{array}$$

4000 nails.

$$2. \quad 4)8642 \text{ nails}$$

$$\begin{array}{r} \hline 5)2160 \text{ 2-nails} \\ \hline \end{array}$$

432 Ells E. 2 na.

$$\begin{array}{r} 3. \quad 324 \text{ Ells Fr.} \\ \quad 6 \\ \hline \end{array}$$

$$\begin{array}{r} 4)1944 \text{ qrs.} \\ \hline \end{array}$$

486 yards

$$\begin{array}{r} 4. \quad 16 \text{ bales} \\ \quad 36 \text{ E. Fl.} \\ \hline \end{array}$$

96

48

576 E. Fl.

3

$$\begin{array}{r} 4)1728 \text{ qrs.} \\ \hline \end{array}$$

432 yards.

LONG MEASURE.

$$\begin{array}{r} 1. \quad 260 \text{ miles} \\ \quad 8 \\ \hline \end{array}$$

$$\begin{array}{r} 2080 \\ \quad 40 \\ \hline \end{array}$$

$$\begin{array}{r} 83200 \\ \quad 5\frac{1}{2} \\ \hline \end{array}$$

$$\begin{array}{r} 416000 \\ 41600 \\ \hline \end{array}$$

$$\begin{array}{r} 457600 \text{ yds.} \\ \quad 3 \\ \hline \end{array}$$

$$\begin{array}{r} 1372800 \text{ feet} \\ \quad 12 \\ \hline \end{array}$$

16473600 inches

$$\begin{array}{r} 2. \quad \begin{array}{cccc} \text{mi.} & \text{fu.} & \text{P.} & \text{yds. ft.} \\ 11 & 7 & 38 & 2 \quad 2 \\ \hline 8 \end{array} \\ \hline \end{array}$$

95

40

3838

5 $\frac{1}{2}$

19192

1919

21111

3

63335

12

760020

3

2280060 b. c.

$$\begin{array}{r}
 3. \quad 3)1267200 \text{ feet} \\
 \hline
 220) 422400 \text{ yards} \\
 \hline
 8) 1920 \text{ furlongs} \\
 \hline
 60) 240 \text{ miles} \\
 \hline
 4 \text{ degrees}
 \end{array}$$

$$\begin{array}{r}
 4. \quad L. \text{ fu. yds. ft. in.} \\
 3 \ 2 \ 110 \ 1 \ 5 \\
 3 \text{ miles} \\
 \hline
 9 \\
 8 \text{ fur.} \\
 \hline
 74 \\
 220 \text{ yds.} \\
 \hline
 1490 \\
 149 \\
 \hline
 16390 \\
 3 \\
 \hline
 49171 \\
 12 \\
 \hline
 590057 \text{ inches}
 \end{array}$$

$$\begin{array}{r}
 5. \quad 360 \text{ degrees round} \\
 60 \text{ miles} \\
 \hline
 21600 \\
 8 \text{ furlongs} \\
 \hline
 172800 \\
 220 \text{ yards} \\
 \hline
 38016000 \\
 3 \text{ feet} \\
 \hline
 114048000 \\
 12 \text{ inches} \\
 \hline
 1368576000
 \end{array}$$

LAND MEASURE.

$$\begin{array}{r}
 1. \quad 25 \text{ acres} \\
 4 \\
 \hline
 100 \\
 40 \\
 \hline
 4000 \text{ perches}
 \end{array}$$

$$\begin{array}{r}
 2. \quad 4|0)17600|0 \text{ perches} \\
 \hline
 4) 4400 \text{ roods} \\
 \hline
 1100 \text{ acres}
 \end{array}$$

Page 43.

$$\begin{array}{r}
 3. \quad 4|00)6400|00 \text{ perches} \\
 \hline
 4|0)160|0 \text{ each share} \\
 \hline
 4) 40 \text{ roods} \\
 \hline
 10 \text{ acres}
 \end{array}$$

$$\begin{array}{r}
 4. \quad 10 \text{ acres} \\
 160 \\
 \hline
 1600 \text{ perches} \\
 30\frac{1}{4} \\
 \hline
 48000 \\
 400 \\
 \hline
 48400 \text{ yards} \\
 9 \\
 \hline
 435600 \text{ feet} \\
 144 \\
 \hline
 62726400 \text{ inches}
 \end{array}$$

CUBIC, OR SOLID MEASURE.

$$1. \quad \begin{array}{c} \text{ft.} \\ 128 \end{array} \begin{array}{c} \text{feet.} \\ 3200 \end{array} (25 \text{ cords}$$

Page 44.

$$2. \quad \begin{array}{c} \text{ton.} \\ 20 \end{array} \begin{array}{c} \text{ft.} \\ \times 50 \end{array} = \begin{array}{c} \text{feet.} \\ 1000 \end{array}$$

$$3. \quad \begin{array}{c} \text{ton.} \\ 30 \end{array} \begin{array}{c} \text{ft.} \\ \times 40 \end{array} \begin{array}{c} \text{cu. in.} \\ \times 1728 \end{array} = \begin{array}{c} \text{cu. in.} \\ 2073600 \end{array}$$

TIME. Page 45.

$$\begin{array}{r}
 1. \quad \begin{array}{c} w. \\ 8 \end{array} \begin{array}{c} d. \\ 2 \end{array} \begin{array}{c} h. \\ 6 \end{array} \begin{array}{c} m. \\ 20 \end{array} \\
 7 \\
 \hline
 58 \\
 24 \\
 \hline
 238 \\
 116 \\
 \hline
 1398 \\
 60 \\
 \hline
 83900 \text{ min.}
 \end{array}$$

$$\begin{array}{r}
 2. \quad \begin{array}{c} da. \\ 365 \end{array} \begin{array}{c} h. \\ 24 \end{array} \text{ 6 in one year} \\
 \hline
 1466 \\
 730 \\
 \hline
 8766 \\
 60 \\
 \hline
 525960 \\
 60 \\
 \hline
 31557600 \text{ sec.} \\
 10 \text{ years} \\
 \hline
 315576000
 \end{array}$$

$$3. \quad \begin{array}{c} \text{yrs.} \\ 1823 \end{array} \begin{array}{c} \text{days} \\ \times 365\frac{1}{4} \end{array} = \begin{array}{c} \text{days} \\ 665850 \end{array} \begin{array}{c} \text{hrs.} \\ 18 \end{array}$$

$$4. \quad \begin{array}{c} w. \\ 1 \end{array} \begin{array}{c} da. \\ \times 7 \end{array} \begin{array}{c} hr. \\ \times 24 \end{array} \begin{array}{c} mi. \\ \times 60 \end{array} \begin{array}{c} sec. \\ \times 60 \end{array} = \begin{array}{c} sec. \\ 604800 \end{array}$$

3*

LIQUID MEASURE. Page 45.

$$\begin{array}{r}
 1. \quad 4 \text{ tuns} \\
 \quad 4 \\
 \hline
 \quad 16 \text{ hhd.} \\
 \quad 63 \\
 \hline
 1008 \text{ galls} \\
 \quad 8 \\
 \hline
 8064 \text{ pints}
 \end{array}$$

$$\begin{array}{r}
 2. \quad \text{pints.} \\
 \quad 8)4032 \\
 \hline
 63) 504 \text{ galls.} \\
 \hline
 \quad 8 \text{ hhd.}
 \end{array}$$

$$3. \quad \text{hhd. gal. pt.} \\ 38 \times 63 \times 8 = 19152 \text{ pints}$$

DRY MEASURE.

$$\begin{array}{r}
 1. \quad 78 \text{ bu. } 3 \text{ pc. } 7 \text{ qt.} \\
 \quad 4 \\
 \hline
 \quad 315 \\
 \quad 8 \\
 \hline
 2527 \\
 \quad 2 \\
 \hline
 5054 \text{ pints}
 \end{array}$$

$$\begin{array}{r}
 2. \quad 2)2196 \\
 \hline
 8) 1098 \\
 \hline
 4) 137 \text{ } 2 \\
 \hline
 34 \text{ bu. } 1 \text{ pc. } 2 \text{ qt.}
 \end{array}$$

ADDITION OF DECIMALS.

Page 47.

$$2. \quad \text{Ans. } 3923400,3687078$$

$$\begin{array}{r}
 3. \quad 283,604 \\
 490006,003275 \\
 21,05 \\
 1,2 \\
 6200,3476 \\
 \hline
 \text{Sum } 496512,204875
 \end{array}$$

$$\begin{array}{r}
 4. \quad ,246 \\
 ,012 \\
 ,02 \\
 ,6 \\
 ,413 \\
 ,5 \\
 \hline
 \text{Sum } 1,791
 \end{array}$$

$$\begin{array}{r}
 5. \quad 26,52 \\
 225,005 \\
 ,0035 \\
 844, \\
 2,2 \\
 300,825 \\
 ,00005 \\
 \hline
 \text{Sum } 1397,55355
 \end{array}$$

$$\begin{array}{r}
 6. \quad 125,5 \\
 10000,000005 \\
 15,072 \\
 2,01 \\
 \hline
 \text{Sum } 10142,582005
 \end{array}$$

$$\begin{array}{r}
 7. \quad 5,4 \\
 15,04 \\
 100,004 \\
 6000,00004 \\
 93880,0004 \\
 \hline
 \text{Sum } 100000,44444
 \end{array}$$

SUBTRACTION OF DECIMALS.

Page 47.

$$2. \quad \text{Ans } 685,495632$$

$$3. \quad \text{Ans. } 8,3047$$

$$4. \quad \begin{array}{r} \text{From } 45,005 \\ \text{Take } 23,65482 \\ \hline \text{Diff. } 21,35018 \end{array}$$

$$5. \quad \begin{array}{r} \text{From } 620,2 \\ \text{Take } 200,002 \\ \hline \text{Diff. } 420,198 \end{array}$$

Page 48.

$$6. \quad \begin{array}{r} \text{From } 5, \\ \text{Take } ,10438 \\ \hline 4,89562 \end{array}$$

$$7. \quad \begin{array}{r} \text{From } 2, \\ \text{Take } ,00002 \\ \hline 1,99998 \end{array}$$

$$8. \quad \begin{array}{r} \text{From } 16, \\ \text{Take } ,016 \\ \hline 15,984 \end{array}$$

MULTIPLICATION OF DECIMALS.

$$4. \quad \begin{array}{r} \text{Mult. } ,385746 \\ \text{by } ,00463 \\ \hline 1157238 \\ 2314476 \\ 1542984 \\ \hline ,00178600398 \end{array}$$

$$5. \quad \begin{array}{r} \text{Mult. } 158,694 \\ \text{by } 23,15 \\ \hline 793470 \\ 158694 \\ 476082 \\ 317388 \\ \hline 367376610 \end{array}$$

$$6. \quad \begin{array}{r} \text{Mult. } ,024653 \\ ,00022 \\ \hline 49306 \\ 49306 \\ \hline ,00000542366 \end{array}$$

$$7. \quad \begin{array}{r} \text{Mult. } 25,04 \\ ,002 \\ \hline ,05008 \end{array}$$

$$8. \quad \begin{array}{r} \text{Mult. } 645,003 \\ ,000005 \\ \hline ,003225015 \end{array}$$

Contraction in Multiplication of Decimals.

Page 50.

$$3. \quad \begin{array}{r} 23,463 \text{ multiplicand} \\ 43,2 \text{ multiplier reversed} \\ \hline 46926 \\ 7039 \\ 938 \\ \hline 54,903 \end{array}$$

$$5. \quad \begin{array}{r} 3,141592 \text{ multiplicand} \\ 8347,25 \text{ mult. rev.} \\ \hline 1570796 \\ 62832 \\ 21991 \\ 1257 \\ 94 \\ 25 \\ \hline 165,6995 \end{array}$$

$$4. \quad \begin{array}{r} 234,216 \text{ multiplic.} \\ 543,2 \text{ mult. rev.} \\ \hline 46843 \\ 7026 \\ 937 \\ 117 \\ \hline 549,23 \end{array}$$

DIVISION OF DECIMALS.

Page 50.

$$3. \quad 23,7)65321,0(2756,16$$

474

1792

1659

1331

1185

1460

1422

380

237

1430

1422

8 rem.

$$6. \quad ,9)9,0$$

10

$$7. \quad ,00463),00178600398(,385746$$

1389

3970

3704

2660

2315

3453

3241

2129

1852

2778

2778

Page 51.

$$8. \quad 2,46),2327898(,09463$$

2214

1138

984

1549

1476

738

738

$$9. \quad ,09463),2327898(2,46$$

18926

43529

37852

56778

56778

Page 51.

$$10. \quad ,018),000162(,009 \\ \quad \quad \quad 162$$

Contraction in Division of Decimals.

Page 52.

4. $1,346787)74,33373(55,193$

67339

6994

6734

260

135

125

121

4

4

5. $9,365407)87,076326(9,297$

84289

2787

1873

914

843

71

65

6

6. $2,45)32,68744231(13,34$

245

818

735

83

73

10

10

7. $6,24),0046872345(,00075$

437

31

31

0*REDUCTION OF DECIMALS.*

Case 1. Page 53.

2. $2)1,0(,5$

3. $4)3,00(,75$

Page 53.

4. 8)7,000(,875

5. 25)1,00(,04

6. 60)57,00(,95

7. 15)6,00(,40 cents

Case 2.

2. $\begin{array}{r} s. \\ 19 \div 20 = ,95 \end{array} \quad \text{£}$

3. $\begin{array}{r} d. \\ 3 \div 12 = ,25 \end{array} \quad s.$

4. $\begin{array}{r} d. \\ 3 \div (12 \times 20) = ,0125 \end{array} \quad \text{£}$

5. $\begin{array}{r} cwt. \quad qr. \quad qr. \\ 4 \quad 2 = 18 \div (20 \times 4) = ,225 \text{ ton} \end{array}$

6. $\begin{array}{r} qr. \quad lb. \quad lb. \\ 2 \quad 14 = 70 \div (28 \times 4) = ,625 \text{ cwt.} \end{array}$

7. $\begin{array}{r} qr. \quad na. \quad na. \\ 3 \quad 3 = 15 \div (4 \times 4) = ,9375 \text{ yds.} \end{array}$

Or thus,

5. $\begin{array}{r|l} qr. & 4 \quad 2, \\ cwt. & 20 \quad 4,5 \end{array}$

6. $\begin{array}{r|l} lb. & 28 \quad 14 \\ & 4 \quad 2,5 \end{array}$

7. $\begin{array}{r|l} na. & 4 \quad 3 \\ qr. & 4 \quad 3,75 \end{array}$

,225 ton.

cwt. ,625

yds. ,9375

Case 3. Page 54.

2. $\begin{array}{r} \text{£} \\ ,75 \\ 20 \end{array}$

3. $\begin{array}{r} lb. \\ ,7 \\ 12 \end{array}$

shillings 15,00

ounces 8,4
20

15 s.

dwts. 8,0 8oz. 8dwts.

4. $\begin{array}{r} ,617 \text{ cwt.} \\ 4 \end{array}$

5. $\begin{array}{r} ,3375 \text{ acres} \\ 4 \end{array}$

qr. $\begin{array}{r} 2,468 \\ 28 \end{array}$

rood. $\begin{array}{r} 1,3500 \\ 40 \end{array}$

lb. $\begin{array}{r} 13,104 \\ 16 \end{array}$

per. 14,0000

oz. $\begin{array}{r} 1,664 \\ 16 \end{array}$

1 rood 14 per.

dr. 10,624

2 qr. 13 lb. 1 oz. 10 dr.

Page 54.

6. *tun.*
 ,258
 4
 —
 hhd. 1,032
 63
 —
 gal. 2,016
 —
 1 hhd. 2 gal.

7. *days.*
 ,761
 24
 —
 hrs. 18,264
 60
 —
 mi. 15,840
 60
 —
 sec. 50,400
 —

18 hr. 15 mi. 50,4 sec.

8. *lb.*
 ,7
 12
 —
 oz. 8,4
 20
 —
 dwt. 8,0
 —
 8 oz. 8 dwt.

9. 365,25 days in a year
 ,3
 —
 days 109,575
 24
 —
 hrs. 13,800
 60
 —
 min. 48,000
 —

109 d. 13 h. 48 m.

10. *day hr. hours*
 ,41 $\times 24 = 9,84$
 ,16
 —
 hrs. 9,68
 60
 —
 min. 40,80
 60
 —
 sec. 48,00

9h. 40 m. 48 sec.

11. *T. cwt. qr. lb.*
 ,17 ,19 ,17 ,7
 20
 —
 cwt. 3,59
 4
 —
 2,53
 28
 —
 15,54

3cwt. 2qr. 15,54lb.

Promiscuous Questions in Decimal Fractions.

Page 55.

Quest. 1. Mult. ,09
by ,009

Prod. ,00081

3. ,9125 ounces
20

dwt. 18,2500

24

gr. 6,0000

18 dwt. 6 gr.

2. ,36 ton
20

7,20 cwt.

4

28,80 qr.

28

23040

5760

806,40 lb.

16

12902,40 oz.

4. 315)4,00(,0127 nearly

oz. dwt. gr.

5. 2 16 20=1364 grains

And 1 pound=5760 grains

Then, 5760)1364,0(,2368

6. ^{miles}
,1392
8

fur. 1,1136
40

per. 4,5440
5½

27200

2720

yds. 2,9920

1 fur. 4 per. 3 yds.

11. 1 doll.=100 cts.

3

15)300

3) 20

6½ cents

7. 4)3,00(,75

8. 112)6,00(,0535714

9. 365)109,5(,3

10. ,04×50×1728=3456

12. ^{hhd.}
,875
63

2625

5250

gall. 55,125
4

qt. ,500

2

pt. 1,000

55 gal. 1 pint

13. 222)1,000(,004504

Page 55.

14. 365,25 days in a year
 ,05

18,2625
 24

730500
365250

438,3000 hr.
 60

26298,0 mi.
 60

1577880 sec.15. ,73 ÷ (3 × ,25) that is
 ,75),73(,973½16.

<i>yr.</i>	<i>w.</i>	<i>d.</i>	<i>h.</i>	<i>m.</i>
,05=2	2	19	12	
<i>hr.</i>				
,5=0	0	0	30	

2w. 2d. 18h. 42 mi.*18.

<i>A.</i>	<i>R.</i>	<i>P.</i>
,6	× 4	× 40
× ,02	=	1,92

17.

<i>T.</i>	<i>h.</i>	<i>gal.</i>
,4	3,	,8
4		
<hr/> 1,9		
63		

120,5 gall.

4

482,0 qt.

2

964 pints19.

<i>cub. in.</i>	<i>ft.</i>	<i>in.</i>
1 ÷ (128 × 1728)		that is
221184)	1,000000	(,000004 +

20. (28 deg. 48 min.) ÷ 360 deg.
that is,

<i>mi.</i>	<i>mi.</i>
21600)	1728,00
	(,08

SINGLE RULE OF THREE DIRECT.

Page 57.

Quest. 2. As 112 : 12,32 :: 16 :

<i>lb.</i>	<i>d.</i>	<i>c.</i>
<i>lb.</i>	<i>cts.</i>	<i>lb.</i>
12,32	× 16	
112	=	1 d. 76 c.

3. As 1 : 36 :: 336 (=3) : 120 dolls. 96 cts.

4.

<i>yds.</i>	<i>yds.</i>	<i>yds.</i>	<i>yds.</i>	<i>yds.</i>
23	+ 24	+ 25	+ 27	= 99 then

<i>yd.</i>	<i>cts.</i>	<i>yds.</i>
As 1	: 72	:: 99 : 99 × 72 = 71 dolls. 28 cts.

* This answer is obtained by reckoning 12 months to the year, 4 weeks to the month, 7 days to a week, &c. But at 52 weeks to the year, the answer will be 2w. 4d. 4h. 18mi. And at 365½ days, it will be 2w. 4d. 5h. 48 mi. the true Answer.

Page 57.

lb. cts. lb.

5. As 4 : 48 :: 512 (4 cwt. 2 qr. 8 lb.) : 61 dolls. 44 cts.

lb. cts. lb.

6. As 1 : 8 :: 128 : 10 dolls. 24 cts.

pair d. c. pair

7. As 114 (=9½ doz.) : 68,40 :: 3 : 1 doll. 80 cts.

bu. d. c. bu.

8. As 20 : 9,60 :: 3 : 1 doll. 44 cts.

cts. yd. d. cts.

9. As 75 : 1 :: 16,50 : 22 yards.

c. qr. lb. d. cts. oz. cts.

10. As 32080 (=17 3 17) : 320,80 :: 6 : 6

Page 58.

*oz. lb. dol. oz. d. c.*11. As 116,4 (=9,7) : 97 :: 1,5 : $\frac{97 \times 1,5}{9,7 \times 12} = 1 \text{ } 25$ *acres dolls. acres*

12. As 125,5 : 627,5 :: 1 : 5 :: 4,75 : 23 doll. 75 cents.

gal. dolls. cts. gal.

13. As 1,5 : 4 50 :: 378 (=1,5 tuns) : 1134 dolls.

d. cts. d. cts. d. cts. d. cts.

14. First 1 66+1 97+2 31=5 94 the price of 1 ream of each sort. Then say—

d. cts. of each sort. d. cts.

As 5 94 : 1 :: 528 66 : 89 reams of each sort.

lb. T. d. lb. qr. lb.

15. As 2240 (=1) : 224 :: 42 (=1 14) : 4 dolls. 20 cts.

d. c. bbl. d. c.

16. As 5 50 : 1 :: 1402,50 : 255 barrels

da. d. cts. da.

17. As 365 : 1186,25 :: 1 : 3 dolls. 25 cents.

Page 58.

18. $\begin{matrix} da. & d. & cts. & da. \end{matrix}$ As 1 : 2 25 :: 365 : 821 dolls. 25 cents, the sum he spends in a year.

Now, 821 dol. 25 cts. + 378 dol. 75 cts. = 1200 dolls.

19. $\begin{matrix} T. & cwt. & qr. & lb. & lb. \end{matrix}$ 4 10 1 12 = 10120

Then, as $\begin{matrix} lb. & cts. & lb. \end{matrix}$ 112 : 1,12 :: 10120 : 101 dolls. 20 cents

20. 4 ft. 6 in. = 54 inches
 $\frac{1}{2}$ of 54 = 27 add

$$\begin{array}{r} \text{---} \\ 81 \\ 27 \\ \text{---} \\ 2187 \\ 9 \\ \text{---} \end{array}$$

19683 solid inches

Then, as $\begin{matrix} cu. in. & cts. & cu. in. \end{matrix}$ 1728 : 110 :: 19683 : 12 dolls. 53 cts. nearly

21. $\begin{matrix} in. & in. & in. & in. \end{matrix}$ (28 + 14) × 14 × 3,5 = 2058 cubic inches

Then, as $\begin{matrix} cu. in. & cts. & cu. in. & d. & cts. & m. \end{matrix}$ 1728 : 190 :: 2058 : 2 26 2+

22. $\begin{matrix} £. & s. & s. & T. & cwt. & qr. & lb. & lb. \end{matrix}$ One ton = 2240 lb. 22 8 = 448 & 203 9 3 3 = 455815

Now, as $\begin{matrix} lb. & s. & lb. & s. \end{matrix}$ 2240 : 448 :: 5 : 1 :: 455815 : 91163 = £4558 3s.

23. $\begin{matrix} d. & c. & yds. & d. & c. & yds. \end{matrix}$ As 11 25 : 5 that is, as 225 : 1 :: 850 50 : 378 in all.

And, as 18 pieces : 378 yds. :: 1 piece : 21 yards

24. $\begin{matrix} hf. & yds. & yds. & d. & £. & s. & d. & hf. & yds. & d. & s. \end{matrix}$ As 25 (= 12½) : 450 (= 1 17 6) :: 2 : 36 = 3

25. $\begin{matrix} ft. & ft. & ft. & in. \end{matrix}$ As 7 : 4 :: 218 9 : 125 feet

Page 58.

A. R. P.

26. 476 3 28=76308 perches. Then say
 P. d. c. P.

As 76308 : 4292 32½ :: 160 : 9 dollars

 da. cts. da. d. cts.

27. As 1 : 214 :: 365 : 781 10 spends

 dolls. cts.

Then, from 1333 00 annual income
 take 781 10 yearly expense

\$551 90 he will save

Page 59.

 bu. d. c. bu.

28. As 321 : 240,75 :: 1 : 75 cents

 na. yds. cts. na. qr. na.

29. As 24(=1½) : 250 :: 6(=1 2) : 62½ cents

 gal. gal. gal.

30. 120½ + 124 + 126¼ = 371¼ gallons

 gal. d. s. d. gal. pence £ s. d.

As 1 : 66(=5 6) :: 371¼ : 24502½ = 102 1 10½

 mi. da. mi.

31. 12×5=60 the distance that A has gone before B starts
 mi. mi.

16—12=4 miles B gains on A per day

 mi. da. mi.

Then, as 4 : 1 :: 60 : 15 days

 £. d. s. d. £ pence £.

32. As 1 : 150(=12 6) :: 1000 : 150000 = 625

 men bbls. men bbls. bbls.

33. As 365 : 75 :: 500 : 102 $\frac{270}{365}$ = 102 $\frac{54}{73}$

35. This is properly a question belonging to the rule of Three Inverse, stated thus,

 cts. A. cts.

As 375 : 360 :: 250 then,

 cts. A.

375×360

 250 cts. = 540 acres.

Page 59.

$$35. \text{ As } \begin{matrix} \text{mi.} \\ 1440 \end{matrix} (=24) : \begin{matrix} \text{hrs.} \\ 25020 \end{matrix} (=360 \times 69\frac{1}{2}) :: \begin{matrix} \text{mi.} \\ 1 \end{matrix} : \begin{matrix} \text{mi. fur.} \\ 17 \quad 3 \end{matrix}$$

SINGLE RULE OF THREE INVERSE.

Page 60.

$$\text{Quest. 2. As } \begin{matrix} \text{men} & \text{days} & \text{men} \\ 60 & : 100 & :: 20 \end{matrix} \quad 3. \text{ As } \begin{matrix} \text{men} & \text{days} & \text{men} \\ 65 & : 4 & :: 5 \end{matrix}$$

$$\begin{array}{r} 2 \overline{) 600} \overline{) 0} \\ \hline \end{array}$$

300 days

$$\begin{array}{r} 5 \overline{) 260} \\ \hline \end{array}$$

52 days

$$4. \text{ As } \begin{matrix} \text{per.} & \text{days} & \text{per.} \\ 6 & : 24 & :: 9 \end{matrix} (=6+3) : \frac{6 \times 24}{9} = 16 \text{ days}$$

$$5. \text{ As } \begin{matrix} \text{cwt.} & \text{miles} & \text{cwt.} \\ 1 & : 150 & :: 6 \end{matrix} : \frac{1 \times 150}{6} = 25 \text{ miles}$$

$$6. \text{ As } \begin{matrix} \text{ft. wide} & \text{yds. long} & \text{ft. wide} \\ 80 & : 300 & :: 60 \end{matrix} : \frac{80 \times 300}{60} = 400 \text{ yards}$$

$$7. \text{ As } \begin{matrix} \text{r. l.} & \text{r. w.} & \text{r. l.} \\ 80 & : 30 & :: 70 \end{matrix} : \frac{80 \times 30}{70} = \frac{8 \times 30}{7} = 34 \text{ r. } 4 \text{ ft. } 8\frac{4}{7} \text{ in.}$$

$$8. \text{ As } \begin{matrix} \text{foot} & \text{feet} & \text{foot} \\ 1 & : 12 & :: 75 \end{matrix} : \frac{12,00}{75} = 16 \text{ feet}$$

$$9. \text{ As } \begin{matrix} \text{yd.} & \text{yds.} & \text{yds.} \\ 75 & : 42,5 & :: 1,25 \end{matrix} : \frac{75 \times 42,5}{1,25} = 25,5 \text{ yards}$$

$$10. \text{ As } \begin{matrix} \text{men} & \text{months} & \text{men} \\ 10 & : 4,5 & :: 15 \end{matrix} (=10+5) : \frac{10 \times 4,5}{15} = 3 \text{ months}$$

$$11. \text{ As } \begin{matrix} \text{dolls.} & \text{yrs.} & \text{dolls.} \\ 80 & : 15 & :: 600 \end{matrix} : \frac{80 \times 15}{600} = 2 \text{ years.}$$

$$12. \text{ As } \begin{matrix} \text{hrs.} & \text{days} & \text{hrs.} \\ 12 & : 4 & :: 16 \end{matrix} : \frac{12 \times 4}{16} = 3 \text{ days}$$

$$13. \text{ As } \begin{matrix} \text{days} & \text{men} & \text{days} \\ 30 & : 400 & :: 50 \end{matrix} : \frac{30 \times 400}{50} = 240 \text{ the number of}$$

men the provisions will serve fifty days

men men
And $400 - 240 = 160$ men must depart.

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$$14. \text{ As } \overset{\text{dolls.}}{292} : \overset{\text{mo.}}{6} :: \overset{\text{dolls.}}{806} : \frac{292 \times 6}{806} = 2 \text{ mo. } 5\frac{170}{806} \text{ da.}$$

$$15. \text{ As } \overset{\text{men}}{1200} : \overset{\text{mo.}}{9} :: \overset{\text{men}}{1600} (=1200+400) : \frac{1200 \times 9}{1600} = 6\frac{3}{4} \text{ mo.}$$

Again,

$$\text{As } \overset{\text{men}}{1200} : \overset{\text{oz.}}{14} :: \overset{\text{men}}{1600} : \frac{1200 \times 14}{1600} = 10\frac{1}{2} \text{ allowance per day}$$

And 14 oz.—10½ oz.=3½ oz. diminution required.

$$16. \text{ As } \overset{\text{rod}}{40} : \overset{\text{rod}}{4} :: \overset{\text{rod}}{25} : \frac{40 \times 4}{25} = 6\frac{2}{5} \text{ rods.}$$

$$17. \text{ As } \overset{\text{in.}}{12} : \overset{\text{in.}}{12} :: \overset{\text{in.}}{3} : \frac{12 \times 12}{3} = 48 \text{ inches.}$$

$$18. \text{ As } \overset{\text{cws.}}{6} : \overset{\text{days}}{91} :: \overset{\text{cws.}}{21} : \frac{6 \times 91}{21} = 26 \text{ days.}$$

$$19. \text{ As } \overset{\text{mi.}}{600} (=10) : \overset{\text{hrs.}}{1} : \overset{\text{pipe}}{24} : \frac{600}{24} = 25 \text{ pipes}$$

$$20. \text{ As } \overset{\text{inches}}{216} (=18) : \overset{\text{ft.}}{10} (=30) :: \overset{\text{ft.}}{18} (= \frac{1}{2}) : \frac{216 \times 10}{18} = 120 \text{ yds.}$$

$$21. \text{ As } \overset{\text{in.}}{75} (= \frac{3}{4}) : \overset{\text{in.}}{208} :: \overset{\text{lb.}}{39} : \frac{75 \times 208}{39} = 4 \text{ lb.}$$

da. mi. mi.

$$22. 5 \times 20 = 100 \text{ A has gone before B starts.}$$

mi. mi.

$$25 - 20 = 5 \text{ miles B gains on A each day.}$$

mi. da. mi. da.

Now, as 5 : 1 :: 100 : 20 B will overtake A.

da. mi. mi.

And 20 × 25 = 500 the distance B must travel.

GENERAL RULE.

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Quest. 3. As $\overset{\text{mo.}}{5} : \overset{\text{mo.}}{2} :: \overset{\text{men}}{800} : \frac{800 \times 2}{5} = 320$ the number of men the provisions will serve for five months.

Then, 800 men—320 men=480 men must depart.

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$$4. \quad \begin{array}{c} \text{galls.} \text{ galls.} \text{ galls.} \\ 63 - 9 = 54 \text{ remains} \end{array}$$

$$\begin{array}{c} \text{dolls.} \text{ dolls.} \text{ dolls.} \\ \text{And } 119 + 12 = 131 \text{ must sell for} \end{array}$$

$$\begin{array}{c} \text{gal.} \text{ gal.} \text{ dol.} \text{ d.} \text{ c.} \text{ m.} \\ \text{Then, as } 54 : 1 :: 131 : \frac{131}{54} = 2 \text{ } 42 \text{ } 5\frac{5}{4} \end{array}$$

$$5. \quad \begin{array}{c} \text{mi.} \text{ mi.} \text{ lb.} \text{ lb.} \\ \text{As } 64 : 512 \text{ that is, as } 1 : 8 :: 225 : 1800 \end{array}$$

$$6. \quad \begin{array}{c} \text{dolls.} \text{ dolls.} \text{ cts.} \text{ cts.} \\ \text{As } 1750 : 10 :: 175 : 1 :: 8750 : 50 \end{array}$$

Promiscuous Questions in Direct and Inverse Proportion.

$$\begin{array}{c} \frac{1}{2} \text{mi.} \text{ mi.} \text{ hr.} \text{ } \frac{1}{2} \text{mi.} \text{ mi.} \text{ hr.} \text{ mi.} \\ \text{Quest. 1. As } 5 (=2\frac{1}{2}) : 1 :: 246 (=123) : 49 \text{ } 12 \text{ going} \end{array}$$

$$\begin{array}{c} \frac{1}{2} \text{mi.} \text{ mi.} \text{ hr.} \text{ } \frac{1}{2} \text{mi.} \text{ hrs.} \text{ mi.} \text{ sec.} \\ \text{And, as } 7 (=3\frac{1}{2}) : 1 :: 246 : 35 \text{ } 8 \text{ } 34\frac{2}{7} \text{ returning} \end{array}$$

$$\begin{array}{c} \text{hrs.} \text{ mi.} \text{ sec.} \\ \text{But } 49 \text{ } 12 \text{ } 0 \\ \quad 35 \text{ } 8 \text{ } 34\frac{2}{7} \end{array}$$

$$\text{Sum } 84\text{h. } 20\text{mi. } 34\frac{2}{7}\text{sec.}$$

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$$\begin{array}{c} \text{dolls.} \text{ da.} \text{ dolls.} \\ \text{Quest. 2. Stated thus, as } 1000 : 189 :: 650 \text{ Inverse pro.} \end{array}$$

$$\begin{array}{c} \text{dolls.} \text{ dolls.} \text{ days.} \\ \text{Or, as } 650 : 1000 :: 189 \text{ by the general rule} \end{array}$$

$$\begin{array}{c} \text{dolls.} \text{ da.} \text{ da.} \\ \text{Then } \frac{1000 \times 189}{650 \text{ dolls.}} = \frac{20 \times 189}{13} = 290\frac{10}{13} \text{ days.} \end{array}$$

$$3. \quad \begin{array}{c} \text{cwt.} \text{ qr.} \text{ lb.} \text{ casks} \text{ lb.} \text{ cwt.} \text{ lb.} \text{ cwt.} \text{ lb.} \\ (1 \text{ } 1 \text{ } 4) \times 14 = 144 \times 14 = 2016 \text{ } 1 = 112 \end{array}$$

$$\begin{array}{c} \text{lbs.} \text{ cts.} \text{ lbs.} \\ \text{Then, as } 112 : 1260 :: 2016 : \frac{12,60 \times 2016}{112} = 226\text{d. } 80\text{c.} \end{array}$$

$$\begin{array}{c} \text{lbs.} \text{ cts.} \text{ lb.} \\ \text{And, as } 112 : 1260 :: 1 : \frac{1260}{112} = \frac{45}{4} = 11 \text{ cts. } 2\frac{1}{2} \text{ ms.} \end{array}$$

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- cwt. qr. lb. chests lb. chest. lb.*
 4. (1 0 14) $\times 4 = 126 \times 4 = 504$ the whole weight.

dolls. cts.

Now, as 1 lb. : 80 cts. :: 126 lb. : 100 80
 1 lb. : 90 cts. :: 126 lb. : 113 40
 1 lb. : 105 cts. :: 126 lb. : 132 30
 1 lb. : 125 cts. :: 126 lb. : 157 50

\$504 00 the amt.

Then, as 504 lb. : 504 dolls. :: 1 lb. : 1 dollar

5. 5oz. $\times 12 = 60$ ounces of bread in a dozen of rolls.

And, as 5 : 4 :: 60oz. : 48oz. the weight of flour in a dozen of rolls.

oz. cwt. dolls. oz.

Then, as 1792 (=1) : 224 :: 8 : 1 :: 48 : 6 cts.

dolls. cts.

6. Cost 780 00
 Freight 37 70
 Other charges 30 60
 Gain 143 00

\$991 30 cts. must sell the whole for

ddl. dolls. cts. ddl.

Then, as 270 : 991 30 :: 1 : 3 dolls. $67\frac{4}{7}$ cts.

7. Half a ton = 10 cwt. = 40 qrs.

As $\frac{\text{horses}}{80} : \frac{\text{qrs.}}{40} :: \frac{\text{horses}}{7} : \frac{40 \times 7}{80} = \frac{7}{2} = 3 \text{ qrs. } 14 \text{ lb.}$

Quest. 8. 12ft = 144 inches, and 9ft. 3in. = 111 inches, 144in. \times 111 in. = 15984 inches. In that distance the large wheel will have made 111 revolutions and the smaller 144 turns. But 144—111 = 33 turns of the less more than the greater in that distance. Now, as 33 turns : 15984 inches distance :: 1000 turns : 484363 $\frac{7}{11}$ inches; this, when reduced to miles, is 7 miles, 5 furlongs, 34 yards, 1 foot, $7\frac{7}{11}$ inches.

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Quest. 9. This question being inverse, say

$$\text{As } \overset{\text{hrs.}}{15} : \overset{\text{da.}}{18} :: \overset{\text{hrs.}}{12} : \frac{15 \times 18}{12} = \frac{15 \times 3}{2} = 22\frac{1}{2} \text{ days.}$$

$\overset{\text{yds.}}{10} \text{ As } \overset{\text{dolls.cts.}}{42,5} : \overset{\text{yds.}}{191,25} :: 1 : 4,5 :: 15 : 67 \text{ dolls. } 50 \text{ cts.}$
 what 15 yards cost; but $\frac{2}{3}$ of 67 dolls. 50 cts. = 45 dolls. the
 amount that 15 yards sells for.

Now, $42\frac{1}{2}$ yards at 1 dollar, comes to 42 dollars 50 cents, whole gain.

$$\begin{array}{r} \overset{\text{d. cts.}}{191} \overset{\text{d. cts.}}{25} + \overset{\text{d. cts.}}{42,50} = 233,75 \text{ must get in all} \\ \text{Subtract } 45,00 \text{ received for 15 yards.} \end{array}$$

Diff. \$188,75 the sum that the remaining
 $27\frac{1}{2}$ yards must bring. But

$$\text{As } \overset{\text{yds.}}{27,5} : \overset{\text{d. c.}}{188,75} :: 1 : \overset{\text{yd. d. c.}}{6,86\frac{4}{11}}$$

11. State by the general rule

$$\text{As } \overset{\text{yds.}}{60} : \overset{\text{yds.}}{10} (=30) :: \overset{\text{ft.}}{6} : 1 :: \overset{\text{ft.}}{18} : 3 \text{ feet}$$

$$12. \text{ As } \overset{\text{rod.}}{40} : \overset{\text{rod.}}{640} (=160 \times 4) :: \overset{\text{rod.}}{1} : \overset{\text{rods.}}{16}$$

$$\text{Or, As } \overset{\text{rod.}}{40} : \overset{\text{rod.}}{160} :: \overset{\text{rod.}}{1} : \overset{\text{rods.}}{4} :: \overset{\text{rod.}}{4} : \overset{\text{rods.}}{16}$$

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13. Because the large wheel has 70 cogs, and the small one 52, the small wheel will make 70 revolutions while the large ones make 52. But $70 - 52 = 18$ revolutions that the small wheel will gain in the same time. Then say,

$$\text{As } \overset{\text{rev.}}{18} : \overset{\text{rev.}}{52} :: \overset{\text{rev.}}{100} : \frac{52 \times 100}{18} = 288\frac{8}{9} \text{ revolutions.}$$

$$14. \overset{\text{feet.}}{1142} \times \overset{\text{sec.}}{60} = \overset{\text{feet.}}{68520} \text{ the dist. sound goes in a minute.}$$

$$\text{Then, as } \overset{\text{pul.}}{70} : \overset{\text{feet}}{68520} :: \overset{\text{pul.}}{20} : \overset{\text{feet}}{19577\frac{1}{7}} = \overset{\text{m. f. yds. ft.}}{3 \ 5 \ 145 \ 2\frac{1}{7}}$$

$$15. \overset{\text{dolls.}}{5+4+3+2+1} = 15 \text{ the cost of 1 yard of each sort.}$$

$$\text{Then, as } \overset{\text{dolls.}}{15} : 1 :: \overset{\text{dolls. cts. yds.}}{532,50} : 35\frac{1}{2}$$

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16. Stated by the general rule it will be

$$\begin{array}{cccc} \text{mo.} & \text{mo.} & \text{dolls.} & \text{dolls.} \\ \text{As } 1 & : 12 & :: 127 & : 1524 \end{array}$$

$$17. \quad \begin{array}{cccc} \text{in.} & \text{in.} & \text{lb.} & \\ \text{As } 5 & : 36 & :: 5 & : \frac{36 \times 5}{5} = 360 \text{ pounds.} \end{array}$$

$$18. \quad \begin{array}{cccc} \text{lb.} & \text{lb.} & & \text{in.} \\ \text{As } 90 & : 5 & \therefore 18 & : 1 :: 36 : 2 \text{ inches} \end{array}$$

19. $\frac{4}{5} = .8$ and $\frac{1}{2} = .5$ therefore it will be

$$\begin{array}{cccccc} \text{yd.} & \text{dolls.} & \text{yds.} & \text{d.} & \text{c.} & \text{m.} \\ \text{As } 1 & : 2,7118 & :: 67,5 & : 183 & 04 & 6\frac{1}{2} \end{array}$$

$$20. \quad \begin{array}{cccc} \text{day} & \text{s.} & \text{d.} & \text{qr.} \\ \text{As } 1 & : 16 & 5 & 1\frac{15}{365} :: 365 \end{array}$$

12

197

4

789

365

3950

4735

2367

$$4) 288000^*$$

$$12) 72000$$

$$2|0) 600|0$$

300l.

*Here omit multiplying by the third number, because you would immediately have to divide by the same number, to bring farthings.

$$21. \quad \begin{array}{cccc} \text{yds.} & \text{qrs.} & \text{ft.} & \text{ft.} \\ 11 \times 3 = 33 & \times 2\frac{1}{4} = 74,25 & \text{in a piece.} \end{array}$$

$$\text{And } 2 \begin{array}{cccc} \text{ft.} & \text{ft.} & \text{ft.} & \text{ft.} \\ (25 + 15) \times 10\frac{1}{2} = 80 \times 10\frac{1}{2} = 840. \end{array}$$

$$\text{But } \begin{array}{cccc} \text{sq. ft.} & \text{sq. ft.} & \text{sq. ft.} & \text{sq. ft.} \\ 840 - \frac{840}{10} = 840 - 84 = 756 & \text{in the walls.} \end{array}$$

$$\text{Then, as } \begin{array}{cccc} \text{sq. ft.} & \text{piece} & \text{sq. ft.} & \\ 74,25 & : 1 & :: 756 & : 10\frac{2}{11} \text{ pieces} \end{array}$$

$$22. \quad \begin{array}{cccc} \text{ft.} & \text{ft.} & \text{in.} & \text{ft.} \\ \text{As } 50 & : 50 & 10\frac{1}{2} & :: 1287 & 4, \text{ that is} \end{array}$$

$$\begin{array}{cccc} \text{in.} & \text{in.} & \text{in.} & \text{in.} \\ \text{As } 600 & : 610\frac{1}{2} & :: 15448 & : 15718\frac{17}{50} = 1309 & 10\frac{17}{50} \end{array}$$

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23. $\begin{matrix} h. pt. & gal. & h. pt. & gal. \\ As & 16 (=1) & : 15 & :: 100 : 93\frac{1}{4} \text{ gallons} \end{matrix}$

DOUBLE RULE OF THREE.

Believing that it will be acceptable to some, I here insert two rules for stating the Double Rule of Three, in addition to that in the W. Calculator.

RULE FIRST. Place the three conditional terms in the following order: that which is the principal cause of gain, loss or action, possesses the first place; that which denotes space of time, or distance of place, the second; and that which is the gain, loss, or action the third; then place the other two terms, which move the question, under those of the same name, and if the blank space falls under the third, multiply the three last terms for a dividend, and the two first for a divisor: but if the blank fall under the first or second place, multiply the first, second, and last terms together for a dividend, and the other two for a divisor; and the quotient will be the answer.

RULE SECOND. Work by two statements of the Single Rule of Three.

Direct Proportion.

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Quest. 2. $\begin{matrix} \text{Horses} & 18 \\ \text{days} & 20 \end{matrix} \left\{ \begin{matrix} 10 \text{ bushels.} \\ \end{matrix} \right. \left\{ \begin{matrix} 60 \text{ horses} \\ 36 \text{ days} \end{matrix} \right.$

Then $\frac{10 \times 60 \times 36}{18 \times 20} = 10 \times 3 \times 2 = 60 \text{ bushels.}$

Or thus,

$\begin{matrix} \text{horses} & \text{days} & \text{bu.} \\ As & 18 : 20 :: 10 \\ & 60 : 36 \end{matrix}$ Then $\frac{10 \times 60 \times 36}{18 \times 20} = 60 \text{ bushels.}$

Or, by two statings,

$\begin{matrix} \text{horses bu.} & \text{horses} \\ As & 18 : 10 :: 60 : 33\frac{1}{4} \text{ bushels.} \end{matrix}$

$\begin{matrix} \text{days bu.} & \text{days bushels} \\ And, as & 20 : 33\frac{1}{4} :: 36 : 60 \text{ as before.} \end{matrix}$

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Stated thus,

$$3. \quad \begin{array}{l} \text{Men } 7 \\ \text{days } 14 \end{array} \left\{ \begin{array}{l} 56 \text{ lb.} \\ \end{array} \right. \left\{ \begin{array}{l} 21 \text{ men} \\ 3 \text{ days} \end{array} \right.$$

Or thus,

$$\begin{array}{l} \text{men days lbs.} \\ 7-14-56 \\ 21-3 \end{array}$$

$$\text{Then } \frac{56 \times 21 \times 3}{7 \times 14} = 4 \times 3 \times 3 = 36 \text{ pounds}$$

Or by two statings,

$$\text{As } \begin{array}{cccc} \text{men} & \text{men} & \text{lb.} & \text{lb.} \\ 7 & : & 21 & :: 56 : 158, \text{ and} \end{array}$$

$$\text{As } \begin{array}{cccc} & \text{days} & \text{days} & \text{lb.} \\ & 14 & : & 3 :: 168 : 36 \text{ pounds.} \end{array}$$

Stated thus,

$$4. \quad \begin{array}{l} \text{Students } 8 \\ \text{months } 6 \end{array} \left\{ \begin{array}{l} \text{dolls.} \\ 384 \end{array} \right. \left\{ \begin{array}{l} 12 \text{ stud.} \\ 10 \text{ mo.} \end{array} \right.$$

Or thus,

$$\begin{array}{l} \text{stu. mo. dolls.} \\ 8-6-384 \\ 12-10 \end{array}$$

$$\text{Then, } \frac{384 \times 12 \times 10}{8 \times 6} = 48 \times 2 \times 10 = 960 \text{ dollars.}$$

Or by two statings,

$$\text{As } \begin{array}{cccc} \text{stu.} & \text{stu.} & \text{dolls.} & \text{dolls.} \\ 8 & : & 12 & :: 384 : 576, \text{ and} \end{array}$$

$$\text{As } \begin{array}{cccc} \text{mo.} & \text{mo.} & \text{dolls.} & \\ 6 & : & 10 & :: 576 : 960 \text{ dollars.} \end{array}$$

Stated thus,

$$5. \quad \begin{array}{l} \text{Cwt. } 20 \\ \text{miles } 50 \end{array} \left\{ \begin{array}{l} \text{dolls.} \\ 25 \end{array} \right. \left\{ \begin{array}{l} 40 \text{ cwt.} \\ 100 \text{ miles} \end{array} \right.$$

Or thus,

$$\begin{array}{l} \text{cwt. mi. dolls.} \\ 20-50-25 \\ 40-100 \end{array}$$

$$\text{Then, } \frac{25 \times 40 \times 100}{20 \times 50} = 25 \times 2 \times 2 = 100 \text{ dollars.}$$

Or by two statings,

$$\text{As } \begin{array}{cccc} \text{cwt.} & \text{cwt.} & \text{dolls.} & \text{dolls.} \\ 20 & : & 40 & :: 25 : 50, \text{ and} \end{array}$$

$$\text{As } \begin{array}{cccc} \text{miles} & \text{miles} & \text{dolls.} & \\ 50 & : & 100 & :: 50 : 100 \text{ dollars.} \end{array}$$

Stated thus,

$$6. \quad \begin{array}{l} \text{Dolls. } 700 \\ \text{months } 6 \end{array} \left\{ \begin{array}{l} \text{dolls.} \\ 14 \end{array} \right. \left\{ \begin{array}{l} 400 \text{ dolls.} \\ 60 \text{ mo.} \end{array} \right.$$

Or thus,

$$\begin{array}{l} \text{dolls. mo. dolls.} \\ 700-6-14 \\ 400-60 \end{array}$$

$$\text{Then, } \frac{14 \times 400 \times 60}{700 \times 6} = 2 \times 4 \times 10 = 80 \text{ dollars.}$$

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Or by two statings,

dolls. dolls. dolls. dolls. mo. mo. dolls.
As 700 : 400 :: 14 : 8 and, As 6 : 60 :: 8 : 80 d.

Statement,

7. Men 4 } rods { 8 men
 12 }
days 6 } { 24 days

Or thus,

men days rods
4— 6—12
8—24

Then, $\frac{12 \times 8 \times 24}{4 \times 6} = 2 \times 8 \times 6 = 96$ rods.

Or by two statings,

men men. rods rods da. days rods
As 4 : 8 :: 12 : 14 and, As 6 : 24 :: 24 : 96 rods.

Inverse Proportion.

Stated thus,

Quest. 2. Men 4 inverse } days { 16 men inverse
 3 }
Dolls. 24 } { 384 dollars.

Or thus,

men days dolls.
4— 3—24
16— —384

Then, $\frac{3 \times 4 \times 384}{16 \times 24} = 3 \times 4 \times 1 = 12$ days

Or by two statings,

dolls. dolls. days days men men days days
As 24 : 384 :: 3 : 48 and, As 16 : 4 :: 48 : 12

3. Dolls. 24 } men { 96 dollars *men days dolls.*
 4 } 4—3—24
day 3 inverse } { inverse 16 days. 16—96

Then, $\frac{4 \times 96 \times 3}{24 \times 16} = \frac{4 \times 4 \times 3}{16} = 3$ men.

Or by two statings,

dolls. dolls. men men days days men men
As 24 : 96 :: 4 : 16 and, As 16 : 3 :: 16 : 3

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Stated thus, Or thus,
 4. Acr. 84 } *men* { 100 acres *men days acres*
 } 7 { 5 days inverse 7—12— 84
 inv. days 12 } { 5—100

$$\text{Then, } \frac{7 \times 100 \times 12}{84 \times 5} = \frac{1 \times 20 \times 1}{1 \times 1} = 20 \text{ men}$$

Or by two statings,
 As $\begin{matrix} \text{acres} & \text{acres} & \text{men} & \text{men} \\ 84 & : & 100 & :: 7 : 8\frac{1}{2} \end{matrix}$ and, As $\begin{matrix} \text{days} & \text{days} & \text{men} & \text{men} \\ 5 & : & 12 & :: 8\frac{1}{2} : 20 \end{matrix}$

Stated thus, Or thus,
 5. Men inv. 7 } *days* { 20 men inv. *men days acres*
 } 12 { 100 acres 7—12— 84
 acres 84 } { 20— 0—100

$$\text{Then, } \frac{12 \times 7 \times 100}{20 \times 84} = \frac{1 \times 1 \times 5}{1 \times 1} = 5 \text{ days}$$

Or by two statings,
 As $\begin{matrix} \text{acres} & \text{days} & \text{acres} & \text{days} \\ 84 & : & 12 & :: 100 : 14\frac{2}{7} \end{matrix}$ and, As $\begin{matrix} \text{men} & \text{men} & \text{days} \\ 20 & : & 7 & :: 14\frac{2}{7} : 5 \text{ days} \end{matrix}$

Stated thus,
 6. Inverse 200 lb. } *miles* { 20200 lb. inverse.
 } 40 { 6060 cents.
 40 cts. }

Or thus, $\begin{matrix} \text{lbs.} & \text{miles} & \text{cts.} \\ 200 & — 40 — & 40 \\ 20200 & — 0 — & 6060 \end{matrix}$

$$\text{Then, } \frac{40 \times 200 \times 6060}{2020 \text{ lb} \times 40 \text{ c.}} = 60 \text{ miles.}$$

Or by two statings,

$\begin{matrix} \text{cts.} & \text{mi.} & \text{cts.} & \text{miles} \\ \text{As } 40 & : & 40 & :: 6060 : 6060, \text{ and} \end{matrix}$

$\begin{matrix} \text{lb.} & \text{lb.} & \text{miles} \\ \text{As } 20200 & : & 200 & :: 6060 : 60 \text{ miles.} \end{matrix}$

Stated thus, Or thus,
 7. \$200 } *w.da.* { 300 dolls. *men w. d. dolls.*
 } 22 6 { 12 men inv. 5—22 6—200
 inv. men 5 } { 12— 0—300

$$\text{Then, } \frac{(22 \text{ w. } 6 \text{ da.}) \times 300 \times 5}{200 \times 12} = 14 \text{ weeks } 2 \text{ days.}$$

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Or by two statings,

dolls. dolls. w. d. w. d.
 As 200 : 300 :: 22 6 : 34 2 and,
men men w. d. w. d.
 As 12 : 5 :: 34 2 : 14 2

Promiscuous Questions.

Quest. 1. Stated thus,

Or thus,

12 oxen } *acres* { 24 oxen *oxen days acres*
 8 days } 10 { 48 days 12—8—10
 24—48—0

Then, $\frac{10 \times 24 \times 48}{12 \times 8} = 120$ acres.

Or by two statings,

ox. ox. acres acres days days acres
 As 12 : 24 :: 10 : 20 and, As 8 : 48 :: 20 : 120 acres

wt. wt. wt.
 2. 8000—4500=3500 and 9 days—6 days=3 days
 4500 cwt. } *horses* { 3500 cwt.
 inverse 6 days } 18 { 3 days inverse
horses days cwt.
 Or thus, 18—6—4500
 0—3—3500

Then, $\frac{18 \times 3500 \times 6}{4500 \times 3} = 28$ horses.

Or by two statings,

cwt. cwt. hor. hor. days days hor. hor.
 As 4500 : 3500 :: 18 : 14 and, As 3 : 6 :: 14 : 28

cwt. hhd. cwt. cwt. bbl. cwt.
 3. 12 × 9 = 108, and 2,5 × 50 = 125.

Stated thus,

108 cwt. } *dolls.* { 125 cwt. *cwt. mi. dolls.*
 60 miles } 100 { 300 miles Or thus, 108—60—100
 125—300—0

Then, $\frac{100 \times 125 \times 300}{108 \times 60} = 578$ dolls. $70\frac{10}{27}$ cents

Or by two statings,

mil. mil. dolls. dolls.
 As 60 : 300 :: 100 : 500, and
cwt. cwt. dolls. dolls. cts.
 As 108 : 125 :: 500 : 578 $70\frac{10}{27}$

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$$4. \quad \begin{array}{l} 3 \text{ yds.} \\ 5 \text{ qrs.} \end{array} \left. \vphantom{\begin{array}{l} 3 \\ 5 \end{array}} \right\} \begin{array}{l} \text{lb.} \\ 1 \end{array} \left\{ \begin{array}{l} 45 \text{ yds.} \\ 4 \text{ qrs.} \end{array} \right. \quad \text{Or,} \quad \begin{array}{l} \text{yds. qrs. lb.} \\ 3-5-1 \\ 45-4-0 \end{array}$$

$$\text{Then, } \frac{1 \times 45 \times 4}{3 \times 5} = 12 \text{ yards}$$

By two statings,

$$\begin{array}{cccc} \text{yds.} & \text{yds.} & \text{lb.} & \text{lb.} \\ \text{As } 3 : 45 :: 1 : 15 \text{ and,} & & \text{qrs.} & \text{qrs.} \\ & & \text{lb.} & \text{lb.} \\ & & \text{As } 5 : 4 :: 15 : 12 \end{array}$$

Or thus,

$$5. \quad \begin{array}{l} 240 \text{ miles} \\ \text{inverse 12 hours} \end{array} \left. \vphantom{\begin{array}{l} 240 \\ \text{inverse 12} \end{array}} \right\} \begin{array}{l} \text{days} \\ 12 \end{array} \left\{ \begin{array}{l} 720 \text{ miles} \\ 16 \text{ hrs. inv.} \end{array} \right. \quad \begin{array}{l} \text{mil. days hrs.} \\ 240-12-12 \\ 720-0-16 \end{array}$$

$$\text{Then, } \frac{12 \times 720 \times 12}{240 \times 16} = \frac{12 \times 3 \times 12}{16} = 27 \text{ days.}$$

By two statings,

$$\begin{array}{cccc} \text{miles} & \text{miles} & \text{days} & \text{days} \\ \text{As } 240 : 720 :: 12 : 36 \text{ and,} & & \text{hrs.} & \text{hrs.} \\ & & \text{days} & \text{days} \\ & & \text{As } 16 : 12 :: 36 : 27 \text{ days} \end{array}$$

$$6. \quad \begin{array}{l} 16,5 \text{ feet} \\ 1,5 \text{ feet} \\ 1 \text{ foot} \end{array} \left. \vphantom{\begin{array}{l} 16,5 \\ 1,5 \\ 1 \end{array}} \right\} \begin{array}{l} \text{dolls. cts.} \\ 1 \quad 25 \end{array} \left\{ \begin{array}{l} 30 \text{ feet} \\ 26 \text{ feet} \\ 4,5 \text{ feet} \end{array} \right.$$

$$\text{Then, } \frac{1,25 \times 30 \times 26 \times 4,5}{16,5 \times 1,5 \times 1} = 177 \frac{27}{11} \text{ dolls. cts.}$$

$$7. \quad \begin{array}{l} 8 \text{ feet} \\ 4 \text{ feet} \\ 4 \text{ feet} \end{array} \left. \vphantom{\begin{array}{l} 8 \\ 4 \\ 4 \end{array}} \right\} 1 \text{ cord} \left\{ \begin{array}{l} 200 \text{ feet long} \\ 10 \text{ feet high} \\ 36 \text{ feet broad} \end{array} \right.$$

$$\text{Then, } \frac{1 \times 200 \times 10 \times 36}{8 \times 4 \times 4} = 562 \frac{1}{2} \text{ cords}$$

$$8. \quad \begin{array}{l} 10 \text{ yards} \\ 6 \text{ qrs.} \end{array} \left. \vphantom{\begin{array}{l} 10 \\ 6 \end{array}} \right\} \begin{array}{l} \text{lb.} \\ 3 \end{array} \left\{ \begin{array}{l} 100 \text{ yards} \\ 3 \text{ qrs.} \end{array} \right.$$

$$\text{Then, } \frac{3 \times 100 \times 3}{10 \times 6} = 15 \text{ pound.}$$

Page 68.

$$9. \quad \begin{array}{l} \text{Inv. 24 men} \\ 200 \text{ ft. long} \\ 8 \text{ ft. high} \\ 6 \text{ ft. thick} \end{array} \left. \vphantom{\begin{array}{l} 24 \\ 200 \\ 8 \\ 6 \end{array}} \right\} \begin{array}{l} \text{days} \\ 80 \end{array} \left\{ \begin{array}{l} 6 \text{ men inverse} \\ 20 \text{ feet long} \\ 6 \text{ feet high} \\ 4 \text{ feet thick} \end{array} \right.$$

$$\text{Then, } \frac{80 \times 24 \times 20 \times 6 \times 4}{6 \times 200 \times 8 \times 6} = 16 \text{ days}$$

Page 68.

10. $\begin{matrix} 9 \text{ persons} \\ 5 \text{ months} \end{matrix} \left\{ \begin{matrix} \text{dolls. } 14 (=9+5) \\ 450 \end{matrix} \right. \begin{matrix} \text{persons} \\ 8 \text{ months} \end{matrix}$

Then $\frac{450 \times 14 \times 8}{9 \times 5} = 1120$ dollars

11. $\left. \begin{array}{l} 8 \text{ persons} \\ 1 \text{ month} \\ 10 \text{ dollars} \end{array} \right\} \text{dolls. } 11\frac{1}{4} \left\{ \begin{array}{l} 12 (=8+4) \text{ persons} \\ 6 \text{ months} \\ 11 \text{ dollars} \end{array} \right.$

Then $\frac{11\frac{1}{4} \times 12 \times 6 \times 11}{8 \times 10} = 111 \text{ } 37\frac{1}{2}$ dolls. cts.

- | | | | | | |
|---------|----------------|---------------|-----|---|------------------|
| 12. | 22,5 feet long | } <i>days</i> | 2,5 | { | 45 feet long |
| | 17,3 feet wide | | | | 34,6 feet wide |
| | 10,25 ft. deep | | | | 12,3 feet deep |
| Inverse | 6 men | | | | 9 men inverse |
| Inverse | 12,3 hours | | | | 8,2 days inverse |

Then $\frac{2,5 \times 45 \times 34,6 \times 12,3 \times 6 \times 12,3}{22,5 \times 17,3 \times 10,25 \times 9 \times 8,2}$ by cancelling*

$$= \frac{2,5 \times 2 \times 2 \times 12,3}{10,25} = \frac{123}{10,25} = 12 \text{ days.}$$

PRACTICE.

Case 1. Page 69.

<i>d. cts.</i>		<i>cts.</i>			250
2.	1,75	Or, 50	$\frac{1}{2}$		125
	250 yards	25	$\frac{1}{2}$		62,50
	<hr/>				<hr/>
	8750				\$437,50
	350				
	<hr/>				
	\$437,50				

* *Cancelling.* That is, when the divisor and dividend are the continued product of a number of factors, you can divide both by the same divisor; and the operation will be greatly abridged.

Thus, in the above example, I observe that 22,5 goes into 45 twice, without a remainder; that 17,3 is contained twice, in 34,6; and that $9 \times 8,2$ goes once into $6 \times 12,3$. Now, by dividing the numerator and denominator by these divisors, we obtain $\frac{2,5 \times 2 \times 2 \times 12,3}{10,25}$ as above.

Page 69.

$$\begin{array}{r} 3. \quad 201 \text{ yds.} \\ \quad 4,20 \\ \hline \end{array}$$

4020

804

\$844,20

$$\text{Or, } \begin{array}{r} 201 \text{ yds.} \\ \quad 4 \\ \hline \end{array}$$

804

20 cts. is $\frac{1}{5} = 40,2$ \$844,20

$$\begin{array}{r} 4. \quad 2210 \text{ yards} \\ \times 1,10 \text{ cents} \\ \hline \end{array}$$

\$2431,00

$$\text{Or, } \begin{array}{c|c|c} \text{cts.} & & 2210 \text{ yards} \\ 10 & \frac{1}{10} & 221 \\ \hline & & 2431 \text{ dollars} \end{array}$$

$$\begin{array}{r} 5. \quad 2,415 \\ \times 421 \text{ yards} \\ \hline \end{array}$$

2415

4830

9660

1016,715

$$\text{Or, } \begin{array}{r} 421 \\ \quad 2 \\ \hline \end{array}$$

cts.

20

20

10 ms.

5

 $\frac{1}{5}$ $\frac{1}{5}$ $\frac{1}{5}$ $\frac{1}{20}$ $\frac{1}{2}$

842

84,2

84,2

4,21

2,105

Or, 1016 dolls. 71 cts. 5 ms.

1016,715

$$\begin{array}{r} 6. \quad 625 \\ \quad 25 \\ \hline \end{array}$$

3125

1250

\$156,25

Or thus,

cts.

26 is $\frac{1}{4}$ 625\$156,25

$$\begin{array}{r} 7. \quad 8275 \\ \quad 4,4 \text{ ms.} \\ \hline \end{array}$$

33100

33100

36410,0

$$\text{Or, } \begin{array}{r} 8275 \\ \hline \end{array}$$

cts.

4 is $\frac{1}{25}$ 4 ms. $\frac{1}{10}$

331

331

364,10

Or, 364 dolls. 10 cts.

$$\begin{array}{r} 8. \quad 8275 \\ \quad 5 \\ \hline \end{array}$$

41375 mills.

$$\text{Or, } \begin{array}{r} 8275 \\ \hline \end{array}$$

5 mills is $\frac{1}{200}$

41,375

Or, 41 dolls. 37 cts. 5 ms.

Case 2. Page 69.

$$\begin{array}{rcl} \text{cwt.} & \text{qr.} & \text{lb. lb.} \\ 2. & 4 & 1 \\ & & 14=490 \end{array}$$

$\frac{1}{4}=122,5$ Or, 122 dolls. 50 cts.

$$\begin{array}{rcl} \text{cwt.} & \text{qr.} & \text{lb. lb.} \\ 3. & 12 & 2 \\ & & 13=1413 \\ & & \times 2 \\ & & \hline & & 3) 2826 \\ & & \hline & & \$942 \end{array}$$

$$\begin{array}{rcl} \text{cwt.} & \text{qr.} & \text{lb. lb.} \\ 4. & 14 & 2 \\ & & 7=1631 \\ & & \times 7 \\ & & \hline & & \text{lb.} \\ & & 5 \times 8=40 \end{array} \begin{array}{r} \\ \\ \\ \hline \\ \hline \end{array} \begin{array}{r} \\ \\ \\ \\ \hline \\ \hline \end{array} \begin{array}{r} \\ \\ \\ \\ \hline \\ \hline \end{array}$$

Application.

Page 70.

Quest. 1. cwt. lb. hhds.
 $12,5 \times 112 \times 6 \times \frac{3}{8} = 3150$ dollars.

$$\begin{array}{r} 2. \quad 60 \text{ ton} \\ \times 3 \\ \hline \end{array}$$

$$5) 180$$

$$\begin{array}{r} \text{ton Eag.} \quad 36 \\ 60 \times 2 = \quad 120 \end{array}$$

$$\hline 156 \text{ Eagles}$$

Or, 1560 dolls.

$$\begin{array}{r} 3. \quad 12,650 \text{ feet} \\ \times 10 \\ \hline \end{array}$$

$$126,500$$

$$\frac{4}{8} \text{ is } \frac{1}{2} = 6,325$$

$$\frac{2}{8} \text{ is } \frac{1}{2} = 3,1625$$

$$\frac{1}{8} \text{ is } \frac{1}{2} = 1,58125$$

$$\hline 137,56875$$

Or, 137 dolls. 66 cts. $8\frac{3}{4}$ ms.

Case 3.

$$\begin{array}{rcl} & \text{dolls. cts.} & \\ 2. & 10 & 94 \\ \text{Mult. by} & 17 \text{ cwt.} & \end{array}$$

$$\hline 7658$$

$$1094$$

$$2 \text{ qr. is one half} \quad 547$$

$$1 \text{ is one half} \quad 2735$$

$$14 \text{ lb. is one half} \quad 13675$$

$$4 \text{ is one seventh} \quad 3907$$

$$1 \text{ is one fourth} \quad 976$$

$$\hline \$196,0408$$

Or, 196 d. 4 cts.

$$\begin{array}{rcl} & \text{dolls. cts.} & \\ 3. & 13 & 41 \\ \text{Mult. by} & 5 \text{ cwt.} & \end{array}$$

$$\hline 67,05$$

$$1 \text{ qr. is } \frac{1}{4} = 3,352\frac{1}{2}$$

$$\hline 70,402\frac{1}{2}$$

70 dolls. 40 cts. $2\frac{1}{2}$ ms.

Page 70.

$$\begin{array}{r}
 \text{dolls. cts. ms.} \\
 4. \quad 15 \quad 00 \quad 5 \\
 \times \quad \quad \quad 7 \\
 \hline
 105,035 \\
 16 \text{ lb. is } \frac{1}{7} = 2,14357 + \\
 2 \text{ lb. is } \frac{1}{8} = ,26794 + \\
 1 \text{ lb. is } \frac{1}{2} = ,13397 + \\
 \hline
 107,58048 +
 \end{array}$$

107 dolls. 58 cts. &c.

Case 4. Page 71.

$$\begin{array}{r}
 \text{s. d.} \qquad \qquad \qquad \text{s. d.} \qquad \qquad \text{Or, 473 yards} \\
 2. \quad 6 \quad 8 \text{ is } \frac{1}{3}) 473 \text{ yds. at } 6 \quad 8 \qquad \qquad 88\frac{8}{9} \text{ cts.} \\
 \hline
 \pounds 157 \quad 13 \quad 4 \qquad \qquad \qquad 3784
 \end{array}$$

$$\begin{array}{r}
 \text{s. d.} \qquad \qquad \qquad \text{s. d.} \\
 3. \quad 3 \quad 4 \text{ is } \frac{1}{6}) 397 \text{ yds. at } 3 \quad 4 \qquad \qquad 420\frac{4}{9} \\
 \hline
 \pounds 66 \quad 3 \quad 4 \qquad \qquad \qquad \$420,44\frac{4}{9}
 \end{array}$$

Or, 397 yards
 $,44\frac{4}{9} \text{ cts.} = 3s. 4d.$

$$\begin{array}{r}
 1588 \\
 1588 \\
 \frac{4}{9} = 176\frac{4}{9} \\
 \hline
 \$176,44\frac{4}{9}
 \end{array}$$

Or, 159,25
 $22\frac{2}{9} \text{ cts.} = 1s. 8d.$

$$\begin{array}{r}
 4. \quad 159\frac{1}{2} \text{ lb. at } 1s. 8d. \qquad \qquad \qquad 31850 \\
 \hline
 1s. 8d. \text{ is } \frac{1}{12}) 159 \quad 5 \text{ value at } 1\pounds. \qquad \qquad 31850 \\
 \hline
 \pounds 13 \quad 5 \quad 5 \qquad \qquad \qquad \frac{2}{9} = 3538\frac{8}{9} \\
 \hline
 \$35,3888\frac{8}{9}
 \end{array}$$

Or, \$35 38 $\frac{8}{9}$

Page 71.

<p>5. 10s. is $\frac{1}{2}$ 658 at 12s</p> <p style="margin-left: 100px;">2 is $\frac{1}{5}$ 329</p> <p style="margin-left: 120px;">65 16</p> <hr style="width: 100px; margin-left: 100px;"/> <p style="margin-left: 100px;">£394 16</p>	<p>Or, 658<i>lb.</i></p> <p style="margin-left: 100px;">160<i>cts.</i> = 12s.</p> <hr style="width: 100px; margin-left: 100px;"/> <p style="margin-left: 100px;">39480</p> <p style="margin-left: 100px;">658</p> <hr style="width: 100px; margin-left: 100px;"/> <p style="margin-left: 100px;">\$1052,80</p>
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<p>6. 10s. is $\frac{1}{2}$ 745 at 16s.</p> <p style="margin-left: 100px;">5s. is $\frac{1}{2}$ 372 10</p> <p style="margin-left: 100px;">1s. is $\frac{1}{5}$ 186 5</p> <p style="margin-left: 120px;">37 5</p> <hr style="width: 100px; margin-left: 100px;"/> <p style="margin-left: 100px;">£596 0</p>	<p>Or, 745 yards</p> <p style="margin-left: 100px;">213$\frac{1}{3}$<i>c.</i> = 16s.</p> <hr style="width: 100px; margin-left: 100px;"/> <p style="margin-left: 100px;">2235</p> <p style="margin-left: 100px;">745</p> <hr style="width: 100px; margin-left: 100px;"/> <p style="margin-left: 100px;">1490</p> <p style="margin-left: 100px;">$\frac{1}{3}$ = 248$\frac{1}{3}$</p> <hr style="width: 100px; margin-left: 100px;"/> <p style="margin-left: 100px;">\$1589,33$\frac{1}{3}$</p>
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<p>7. 10s. is $\frac{1}{2}$ 969 at 19s. 11<i>d.</i></p> <p style="margin-left: 100px;">5 ' $\frac{1}{4}$ 484 10</p> <p style="margin-left: 100px;">4 ' $\frac{1}{5}$ 242 5</p> <p style="margin-left: 100px;">8<i>d.</i> ' $\frac{1}{6}$ 193 16</p> <p style="margin-left: 100px;">2 ' $\frac{1}{4}$ 32 6</p> <p style="margin-left: 100px;">1 ' $\frac{1}{2}$ 8 1 6</p> <p style="margin-left: 120px;">4 0 9</p> <hr style="width: 100px; margin-left: 100px;"/> <p style="margin-left: 100px;">£964 19 3</p>	<p>Or,</p> <p style="margin-left: 100px;">969</p> <p style="margin-left: 100px;">265$\frac{5}{9}$<i>cts.</i> = 19s. 11<i>d.</i></p> <hr style="width: 100px; margin-left: 100px;"/> <p style="margin-left: 100px;">4845</p> <p style="margin-left: 100px;">5814</p> <p style="margin-left: 100px;">1938</p> <p style="margin-left: 100px;">$\frac{5}{9}$ = 538$\frac{1}{3}$</p> <hr style="width: 100px; margin-left: 100px;"/> <p style="margin-left: 100px;">\$2573,23$\frac{1}{3}$</p>
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<p>8. 5s. $\frac{1}{4}$ 3715 at 9s. 4$\frac{1}{2}$<i>d.</i></p> <p style="margin-left: 100px;">4 $\frac{1}{5}$ 928 15</p> <p style="margin-left: 100px;">4<i>d.</i> $\frac{1}{12}$ 743 0</p> <p style="margin-left: 100px;">$\frac{1}{2}$ $\frac{1}{8}$ 61 18 4</p> <p style="margin-left: 120px;">7 14 9$\frac{1}{2}$</p> <hr style="width: 100px; margin-left: 100px;"/> <p style="margin-left: 100px;">£1741 8 1$\frac{1}{2}$</p>	<p>Or, 3715</p> <p style="margin-left: 100px;">125<i>c.</i> = 9s. 4$\frac{1}{2}$<i>d.</i></p> <hr style="width: 100px; margin-left: 100px;"/> <p style="margin-left: 100px;">18575</p> <p style="margin-left: 100px;">7430</p> <hr style="width: 100px; margin-left: 100px;"/> <p style="margin-left: 100px;">3715</p> <hr style="width: 100px; margin-left: 100px;"/> <p style="margin-left: 100px;">\$4643,75</p>
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Page 71.

9.		4567 at 19s. 11½d.	Or, 4567	
10s.	$\frac{1}{2}$			266 $\frac{1}{9}$ c. = 19s. 11½d.
5	$\frac{1}{4}$	2283 10		
4	$\frac{1}{5}$	1141 15	27402	
8d.	$\frac{1}{6}$	913 8	27402	
2	$\frac{1}{4}$	152 4 8	9134	
1	$\frac{1}{2}$	38 1 2	$\frac{1}{9}$ = 507 $\frac{4}{9}$	
$\frac{1}{2}$	$\frac{1}{2}$	19 0 7		
		9 10 3½		
		<hr/>		
		£4557. 9 8½		

Case 5. Page 72.

2.	£.	s.	d.	3.	£.	s.	d.
	89	6	8 × 1		8	11	5
			6				9
			<hr/>				<hr/>
	536	0	0		77	2	9
			6				8
			<hr/>				<hr/>
cwt.	3216	0	0		617	2	0
10 is $\frac{1}{2}$	89	6	8	2 qr. is $\frac{1}{2}$	4	5	8½
4 ' $\frac{1}{5}$	44	13	4	1 ' $\frac{1}{2}$	2	2	10½
2qr. ' $\frac{1}{8}$	17	17	4	16 lb. ' $\frac{1}{7}$	1	4	5¾+
14lb. ' $\frac{1}{4}$	2	4	8	8 ' $\frac{1}{2}$	0	12	2¾+
	0	11	2	2 ' $\frac{1}{4}$	0	3	0½+
			<hr/>	1 ' $\frac{1}{2}$	0	1	6¼
	£3370	13	2				<hr/>
					£625	11	10
4.	£.	s.	d.		A.	R.	P.
	3	17	6	5.	476	3	28
			12		£	3 7s.	11d.
			<hr/>				<hr/>
	46	10	0	5s. is $\frac{1}{4}$	1428		
			12	2s. 6d. ' $\frac{1}{2}$	119		
			<hr/>	5d. ' $\frac{1}{6}$	59 10		
	558	0	0	2r. is $\frac{1}{2}$	9 18 4		
2qr. is $\frac{1}{2}$	1	18	9	1 ' $\frac{1}{2}$	1 13 11½		
14lb. ' $\frac{1}{4}$	0	9	8¼	20p. ' $\frac{1}{2}$	0 16 11¾		
7 ' $\frac{1}{2}$	0	4	10	8 ' $\frac{1}{5}$	8 5¾+		
			<hr/>		3 4¾		
	£560	13	3¼				<hr/>
					£1619	11	1¾

Page 72.

6.	<i>d. c.</i>	
	10,55	
	640 acres	
	<hr/>	
	42200	
	6330	
2r. is $\frac{1}{2}$	5275	
20p. $\frac{1}{4}$	1318 $\frac{3}{4}$	
	<hr/>	
	\$6758,593 $\frac{3}{4}$	
	<hr/>	
	Or, 6758d. 59c. 3 $\frac{3}{4}$ m.	

7.	<i>d. c.</i>	
	18,50	
	229 acres	
	<hr/>	
	16650	
	370	
	370	
2r. is $\frac{1}{2}$	925	
1. ' $\frac{1}{2}$	4625	
10p. ' $\frac{1}{4}$	1156 $\frac{1}{4}$	
8 ' $\frac{1}{5}$	925	
	<hr/>	
	\$4252,456 $\frac{1}{4}$	
	<hr/>	
	Or, 4252d. 45c. 6 $\frac{1}{4}$ m.	

8.	<i>d. cts.</i>	
	6,34	
	12	
	<hr/>	
lb.	7608	
7 is $\frac{1}{16}$	396 $\frac{1}{4}$	
	<hr/>	
	\$76,476 $\frac{1}{4}$	
	<hr/>	
	Or, 76d. 47c. 6 $\frac{1}{4}$ m.	

9.	<i>dolls.</i>	
	14	
	17 cwt.	
	<hr/>	
	238	
2qr. is $\frac{1}{2}$	7	
1 ' $\frac{1}{2}$	35	
14lb. ' $\frac{1}{2}$	175	
7 ' $\frac{1}{2}$	875	
3 $\frac{1}{2}$ ' $\frac{1}{2}$	437 $\frac{1}{2}$	
	<hr/>	
	\$251,562 $\frac{1}{2}$	
	<hr/>	
	Or, 251d. 56c. 2 $\frac{1}{2}$ m.	

10.	<i>d. c.</i>	
	125,50	
	16	
	<hr/>	
	200800	
2r. is $\frac{1}{2}$	6275	
1 ' $\frac{1}{2}$	31375	
20per. ' $\frac{1}{2}$	15687 $\frac{1}{2}$	
5 ' $\frac{1}{4}$	3921 $\frac{7}{8}$	
	<hr/>	
	\$2121,734 $\frac{3}{8}$	
	<hr/>	
	Or, 2121d. 73c. 4m. +	

Page 72.

	£.	s.	d.	
11.	3	17	6	
			5	
	19	7	6	
			5	
	96	17	6	value of 25 cwt.
2qr. is $\frac{1}{2}$	1	18	9	“ of 2 qrs.
1 “ “ $\frac{1}{2}$	0	19	$4\frac{1}{2}$	“ of 1 qr.
14lb. “ $\frac{1}{2}$		9	$8\frac{1}{4}$	“ of 14 lb.
	£100	5	$3\frac{3}{4}$	

TARE AND TRET.

Page 73.

		cwt.	qr.	lb.	lb.	
Quest. 2.	No. 1.	2	1	25	tare	21
	“ 2.	2	2	0	“	21
	“ 3.	2	0	21	“	21
	Gross	7	0	18	tare	63 lb.=2 qr. 7 lb.
	Tare		2	7		
	Neat cwt.	6	2	11		

	d. c.		cwt.	qr.	lb.	lb.	
	12,50		3.	16	1	3=1823	gross
	6					132	tare
2qrs. is $\frac{1}{2}$	75,00					1691	neat
8lb. “ $\frac{1}{7}$	6,25					Mult. ,45	cts.
2 “ “ $\frac{1}{4}$	892 $\frac{6}{7}$						
1 “ “ $\frac{1}{2}$	223 $\frac{3}{4}$					8455	
	111 $\frac{17}{28}$					6764	
	\$82,477 $\frac{19}{28}$					\$760,95	

Page 74.

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16lb. is	17	2,40
8	12	1,20
2	14	30
1	12	15
<hr/>		
\$373,65 cost		
\$261,00 gave		
<hr/>		
\$112,65 due		

	<i>cwt.</i>	<i>qr.</i>	<i>lb.</i>	<i>dolls.</i>
5.	4	2	26	9
			12	50 cwt.
<hr/>				<hr/>
	56	3	4 gross	450
8lb. is	$\frac{1}{14}$	4	0	6+
4	$\frac{1}{2}$	2	0	3+
	6	0	9 tare	
<hr/>				<hr/>
Cwt.	50	2	23 neat	\$456,34 $\frac{3}{4}$

2qr. is $\frac{1}{2}$ 4,50

14 ' $\frac{1}{4}$ 1,12 $\frac{1}{2}$

7 ' $\frac{1}{2}$ 56 $\frac{1}{4}$

2 ' $\frac{1}{7}$ 16+

<i>cwt.</i>	<i>lb.</i>	<i>cwt.</i>	<i>qr.</i>	<i>lb.</i>
6.	6=672 gross	7.	120 3=13524 gross	
	100 tare		177 tare	
<hr/>		<hr/>		
	572		13347	
1/20=	22 tret	1/20=	513,346 tret	
<hr/>		<hr/>		
lb.	550 neat		12833,654	
				,73 cents
lbs.	cts.	lbs.	cts.	
As 550 :	8250 ::	1 :	8250	
<hr/>				
			550=15	
				38500962
				89835578
				<hr/>
				9368,56742

Or, 9368 dolls. 56 cts. 7 ms.

Page 74.

	<i>cwt. qr. lb.</i>	
8.	6 2 12	16 dollars
	9	50 cwt.
	<hr/>	
	59 1 24 gross	800
	<hr/>	
16lb. is $\frac{1}{7}$	8 1 27	1qr. is $\frac{1}{4}$ 4
1 ' $\frac{1}{16}$	2 3	14lb. ' $\frac{1}{2}$ 2
	<hr/>	7 ' $\frac{1}{2}$ 1
	9 0 2 tare	1 ' $\frac{1}{7}$ 0,14 $\frac{2}{7}$
	<hr/>	
Cwt. 50	1 22 neat	\$807,14 $\frac{2}{7}$

$$\begin{array}{l} \text{lb. cwt. qr. lb. bags lb.} \\ 9. \quad 325(=2 \ 3 \ 17) \times 27 = 8775 \text{ gross} \\ \quad 8775 \text{ lb.} \times \frac{1}{16} = 1018 \text{ tare} \\ \hline \quad 7757 \\ 7757 \div 26 = 298 \text{ tret} \end{array}$$

$$7459 \text{ lb.} = 66 \text{ cwt. } 2 \text{ qr. } 11 \text{ lbs.}$$

$$\begin{array}{l} \text{lbs. ct. dolls. cts.} \\ \text{And } 7459 \times 32 = 2386,88 \end{array}$$

SIMPLE INTEREST.

Case 1. Page 75.

$$\begin{array}{l} \text{dolls. dolls. yr. cts.} \\ 4. \quad 200 \times 6 \times 2 = 2400 = 24 \text{ dollars.} \end{array}$$

Page 76.

$$\begin{array}{l} \text{dolls. dolls. yrs. cts. dolls. cts.} \\ 5. \quad 1260 \times 7 \times 4 = 35280 = 352,80 \end{array}$$

$$\begin{array}{l} \text{dolls. dolls. yrs. cts. dolls. cts.} \\ 6. \quad 560 \times 8 \times 3 = 13440 = 134,40 \end{array}$$

$$\begin{array}{l} \text{d. cts. 'd. d. cts.} \\ \text{Now } 134,40 + 560 = 694,40 \end{array}$$

$$\begin{array}{l} \text{d. d. yrs. cts. d. cts.} \\ 7. \quad 4520 \times 5 \times 6 = 135600 = 1356,00 \end{array}$$

$$\begin{array}{l} \text{d. cts. d.} \\ \text{And } 1356,00 + 4520 = 5876 \text{ dollars.} \end{array}$$

Page 76.

$$\begin{array}{l} \text{dolls. d. yrs. cts.} \qquad \qquad \qquad \text{d. d. d.} \\ 8. \quad 400 \times 6\frac{1}{2} \times 2 = 5200 = 52 \text{ dolls.} \quad \text{And } 52 + 400 = 452 \end{array}$$

$$\begin{array}{l} \text{dolls. dolls. yrs. cts} \qquad \qquad \text{d. cts. ms.} \\ 9. \quad 4925 \times 7\frac{1}{2} \times 9 = 332437\frac{1}{2} = 3324 \text{ } 37 \text{ } 5 \end{array}$$

$$\begin{array}{l} \text{dolls. dolls. cts. dolls. cts.} \\ 10. \quad 2500 \times 7\frac{3}{4} = 19375 = 193 \text{ } 75 \end{array}$$

$$\begin{array}{l} \text{d. c. d. d. cts.} \\ \text{And } 193 \text{ } 75 + 2500 = 2693 \text{ } 75 \end{array}$$

Case 2. Page 77.

$$\begin{array}{r} \begin{array}{l} \text{dolls. c. ms.} \\ 4. \quad 1260 \text{ } 50 \text{ } 5 \\ \qquad \qquad \qquad 7\frac{1}{2} \\ \hline 8823535 \\ 6302525 \\ \hline \end{array} \qquad \begin{array}{l} \text{d. cts. ms.} \\ \text{Now } 283 \text{ } 61 \text{ } 3 + \\ \qquad \qquad \qquad 1260 \text{ } 50 \text{ } 5 \\ \hline \$1544 \text{ } 11 \text{ } 8 \text{ amount} \end{array} \end{array}$$

cents 9453,7875 interest for 1 year
3

28361,3625

Or, 283 dolls. 61 cts. 3 + ms. interest for three years.

$$\begin{array}{l} \text{dolls. cts.} \qquad \qquad \text{dollars cts. d. yrs. d. cts. ms.} \\ 5. \quad 630 \text{ } 50 \qquad 6. \quad 3462 \text{ } 84 \times 3\frac{1}{2} \times 4 = 450 \text{ } 1692 \text{ int.} \\ \qquad \qquad \qquad 8 \qquad \qquad \qquad 1274 \text{ } 646 \times 7\frac{1}{2} \times 3 = 286 \text{ } 79535 \text{ int.} \end{array}$$

$$\begin{array}{l} 50 \text{ } 4400 \text{ int. for 1 year} \qquad \qquad \qquad 163 \text{ } 37385 \text{ diff.} \\ \qquad \qquad \qquad 5 \end{array}$$

252 20 int. for 5 years

630 50 principal

$$\begin{array}{l} \text{dolls. cts. ms.} \\ \text{Or, } 163 \text{ } 37 \text{ } 3,85 \end{array}$$

\$882 70 amount

$$\begin{array}{l} \text{dolls. cts.} \\ 7. \quad 3 \text{) } 3422 \text{ } 25 \end{array}$$

$$\begin{array}{l} \text{dolls. cts. ms.} \\ 1140 \text{ } 75 \times \frac{6}{100} = 68 \text{ } 44 \text{ } 5 \text{ int. for 1 year} \\ 68 \text{ } 44 \text{ } 5 \text{ interest for one year} \end{array}$$

1209 19 5 first payment.

Question seven continued.

<i>d. c. m. yr.</i>	<i>dolls. cts.</i>		<i>d. c. m.</i>	<i>dolls. cts.</i>
68,44,5	$\times 2 =$	136 89	int. for 2 yrs.	68,44,5 $\times 3 =$ 205 335
		<u>\$1277 64</u>	2d payment	3d pay't. <u>1346 085</u>
		<i>d. c. ms.</i>		
		Now, 1209 19 5	first payment	
		1277 64 0	second	
		1346 08 5	third	
		<u>\$3832 92 0</u>	whole amount	

Case 3. Page 78.

4.	18 months	Then, 724 dollars
	4 per cent.	6
	<u>12) 72</u>	<u>\$43,44</u> interest
		724,00 principal
	6 rate for the time	<u>\$767 44</u> amount.
5.	15 months	<i>d. c. m.</i>
	$7\frac{1}{2}$ per cent.	Then, 9 375
	<u>12) 112$\frac{1}{2}$</u>	240 dollars.
		<u>375000</u>
	9,375 rate for the time	18750
		<u>22,50000</u>

Or, 22 dollars 50 cents.

6.	4 months	<i>dolls.</i>
	$6\frac{1}{2}$ per cent.	Then, 1260
	<u>12) 26</u>	<u>2$\frac{1}{6}$</u>
		2520
	$2\frac{1}{6}$ rate for the time	210
		<u>\$27 30</u> cents.

Case 4. Page 80.

$$5. \quad \begin{array}{ccccccc} \text{dolls.} & \text{days} & (\text{constant div.}) & d. & \text{cts.} & & \\ (12000 \times 40) & \div & 5214 & = & 92 & 06 & \text{nearly} \end{array}$$

$$6. \quad \begin{array}{ccccccc} \text{dolls.} & \text{days} & (c. d.) & d. & \text{cts.} & \text{ms.} & \\ (8400 \times 20) & \div & 7300 & = & 23 & 01 & 3 \end{array}$$

$$7. \quad \begin{array}{ccccccc} d. & \text{cts.} & \text{days} & (c. d.) & & & \\ (517 \ 90 \times 84) & \div & 6083 & = & 7 & \text{dolls.} & 15 \text{ cts. } 1 \text{ m.} \end{array}$$

$$8. \quad \begin{array}{ccccccc} d. & \text{cts.} & \text{days} & (c. d.) & & & \\ (73 \ 41 \times 27) & \div & 60 & = & 33 & \text{cts.} & \end{array}$$

$$9. \quad \begin{array}{ccccccc} \text{dolls.} & \text{cts.} & \text{days} & (c. d.) & d. & c. & m. \\ (225 \ 24 \times 40) & \div & 6083 & = & 1 & 48 & 1 \end{array}$$

$$10. \quad \begin{array}{ccccccc} \text{dolls.} & \text{days} & (c. d.) & d. & c. & m. & \\ (1200 \times 80) & \div & 6083 & = & 15 & 78 & 1 \end{array}$$

$$11. \quad \begin{array}{ccccccc} \text{dollars} & \text{cts.} & \text{days} & (c. d.) & d. & \text{cts.} & m. \\ (2962 \ 19 \times 254) & \div & 6083 & = & 123 & 68 & 8 \end{array}$$

$$12. \quad \begin{array}{ccccccc} d. & \text{cts.} & \text{days} & (c. d.) & d. & c. & m. \\ (1733 \ 97 \times 102) & \div & 6083 & = & 29 & 07 & 5 \end{array}$$

Case 5. Page 81.

$$2. \quad \begin{array}{cccc} \text{yrs.} & d. & d. & d. \\ (12 \times 6) + 100 & = & 172 & \text{Then,} \end{array}$$

$$\text{As } \begin{array}{ccccccc} \text{dolls.} & \text{dolls.} & \text{dolls.} & & \text{dolls.} & & \\ 172 & : & 100 & :: & 2752 & : & \frac{2752 \times 100}{172} = 1600 \end{array}$$

$$3. \quad \begin{array}{cccc} \text{yrs.} & d. & d. & d. \\ (5 \times 6) + 100 & = & 130 & \text{Then,} \end{array}$$

$$\text{As } \begin{array}{ccccccc} \text{dolls.} & \text{dolls.} & \text{dolls.} & & \text{dolls.} & & \\ 130 & : & 100 & :: & 728 & : & \frac{728 \times 100}{130} = 560 \end{array}$$

$$4. \quad \begin{array}{cccc} \text{yrs.} & d. & d. & d. \\ (4 \times 7\frac{1}{2}) + 100 & = & 130 & \text{Then,} \end{array}$$

$$\text{As } \begin{array}{ccccccc} \text{dolls.} & \text{dolls.} & \text{dolls.} & & \text{dolls.} & & \\ 130 & : & 100 & :: & 1638 & : & \frac{1638 \times 100}{130} = 1260 \end{array}$$

$$5. \quad \begin{array}{ccccccc} \text{yrs.} & d. & \text{cts.} & d. & d. & \text{cts.} & \\ (5 \times 5 \ 75) + 100 & = & 128 \ 75 & \text{Then,} \end{array}$$

$$\text{As } \begin{array}{ccccccc} \text{dolls.} & \text{cts.} & \text{dolls.} & \text{dolls.} & & \text{dolls.} & \text{cts.} & \text{ms.} \\ 128 \ 75 & : & 100 & :: & 2000 & : & \frac{2000 \times 100}{128,75} = 1553 & 39 \ 8\frac{6}{103} \end{array}$$

Case 6. Page 82.

$$2. \begin{array}{l} \text{dolls.} \\ 858 \text{ amount} \\ 650 \text{ principal} \\ \hline \end{array} \quad \text{As } \begin{array}{l} \text{dolls.} \\ 650 \end{array} : \begin{array}{l} \text{dolls.} \\ 208 \end{array} :: \begin{array}{l} \text{dolls.} \\ 100 \end{array} : \frac{20800}{650} = 32$$

Then $32\text{d.} \div 4 \text{ yrs.} = 8 \text{ per cent.}$

\$208 interest

$$3. \begin{array}{l} \text{dolls.} \\ 2752 \text{ amount} \\ 1600 \text{ prin.} \\ \hline \end{array} \quad \text{As } \begin{array}{l} \text{dolls.} \\ 1600 \end{array} : \begin{array}{l} \text{dolls.} \\ 1152 \end{array} :: \begin{array}{l} \text{dolls.} \\ 100 \end{array} : \frac{115200}{1600} = 72$$

\$1152 interest. Then $72 \text{ dolls.} \div 12 \text{ yrs.} = 6 \text{ dollars}$

$$4. \begin{array}{l} \text{dolls. cts.} \\ 860,80 \text{ amount} \\ 640,00 \text{ prin.} \\ \hline \end{array} \quad \text{As } \begin{array}{l} \text{dolls.} \\ 640 \end{array} : \begin{array}{l} \text{dolls. cts.} \\ 220,80 \end{array} :: \begin{array}{l} \text{dolls.} \\ 100 \end{array} : \frac{22080}{640} = 34\frac{1}{2}$$

\$220,80 interest. Then $34\frac{1}{2} \text{ d.} \div 6 \text{ yrs.} = 5\frac{3}{4} \text{ per cent.}$

$$5. \begin{array}{l} \text{dolls.} \\ 20100 \text{ amount} \\ 12000 \text{ prin.} \\ \hline \end{array} \quad \text{As } \begin{array}{l} \text{dolls.} \\ 12000 \end{array} : \begin{array}{l} \text{dolls.} \\ 8100 \end{array} :: \begin{array}{l} \text{d.} \\ 100 \end{array} : \frac{810}{12} = 67\frac{1}{2}$$

\$ 8100 interest. Then $67\frac{1}{2} \text{ d.} \div 15 \text{ yrs.} = 4\frac{1}{2} \text{ per cent.}$

Case 7. Page 83.

$$2. \begin{array}{l} \text{dolls.} \\ 650 \\ 8 \\ \hline \end{array} \quad \begin{array}{l} \text{dolls.} \\ 910 \text{ amount} \\ 650 \text{ principal} \\ \hline \end{array}$$

\$52,00 int. for 1 year \$260 whole interest

Then, as $\begin{array}{l} \text{dolls. year} \\ 52 : 1 \end{array} :: \begin{array}{l} \text{dolls.} \\ 260 \end{array} : \frac{260}{52} = 5 \text{ years}$

$$3. \begin{array}{l} \text{dolls.} \\ 1600 \\ 6 \\ \hline \end{array} \quad \begin{array}{l} \text{dolls.} \\ 2080 \text{ amount} \\ 1600 \text{ principal} \\ \hline \end{array}$$

\$96,00 int. for 1 year \$ 480 whole interest

Then, as $\begin{array}{l} \text{dolls. year} \\ 96 : 1 \end{array} :: \begin{array}{l} \text{dolls.} \\ 480 \end{array} : \frac{480}{96} = 5 \text{ years}$

Case 8. Page 83.

2. 640£. 3s. 6d. = $2845\frac{2}{9}$ dollars
5

\$142,26 $\frac{1}{9}$ interest for 1 year
3

426,78 $\frac{1}{3}$ interest for 3 years
2845,22 $\frac{2}{9}$ principal

\$3272,00 $\frac{5}{9}$ amount*

	£.	s.	d.		£.	s.	d.	
3.	1374	1	9		77	5	10	in'st. for 1 yr.
rate per cent.		5 $\frac{5}{8}$			38	12	11	for $\frac{1}{2}$ yr.

6870 8 9 £115 18 9 int. for 1 $\frac{1}{2}$ yr.

$\frac{4}{8}$ is $\frac{1}{2}$ 687 0 10 $\frac{1}{2}$
 $\frac{1}{8}$ is $\frac{1}{4}$ 171 15 2 $\frac{1}{2}$

£77,29 4 10
20

s. 5,84
12

d. 10,18

Case 9. Page 85.

2. 1820, January.	Principal	1800 dollars
<i>dolls.</i>	<i>days</i>	
1821—April 1. 1800	Mult. by	455 equal 819000
paid 700		
1822—Jan. 1. 1100	Mult.	275 equal 302500
paid 400		
700	Mult.	181 equal 126700
July 1, paid 500		
200	Mult.	184 equal 36800
214 16 6		
Amount due \$414 16 6		6,0) 128500,0
	Interest	\$ 214,166

* The answer given with the question is obtained by reckoning \$4,44 to be a pound sterling, instead of \$4,44 $\frac{4}{9}$

COMPOUND INTEREST.

Page 87.

$$3. \quad \begin{array}{l} \text{tabular number} \quad \text{dolls.} \quad \text{d.} \quad \text{cts.} \\ 1,27628 \times 1500 = 1914 \quad 42 \end{array}$$

$$4. \quad \begin{array}{l} \text{tabular no.} \quad \text{d.} \quad \text{d.} \quad \text{c.} \quad \text{m.} \\ 2,54035 \times 4500 = 11431 \quad 57 \quad 5 \quad \text{amount} \\ \text{subtract} \quad 4500 \quad \text{principal} \\ \hline \$6931 \quad 57 \quad 5 \quad \text{interest} \end{array}$$

$$5. \quad \begin{array}{l} \text{tabular no.} \quad \text{d.} \quad \text{d.} \quad \text{cts.} \\ 3,20713 \times 650 = 2084 \quad 63 \quad 4,5 \text{ mills} \end{array}$$

$$6. \quad \begin{array}{l} \text{yrs.} \quad \text{yrs.} \\ 21 - 4 = 17 \text{ years, on interest.} \quad \text{Then,} \end{array}$$

$$\begin{array}{l} \text{tabular no.} \quad \text{d.} \quad \text{d.} \quad \text{cts.} \\ 2,69277 \times 8000 = 21542 \quad 16 \quad \text{amount} \end{array}$$

$$\begin{array}{l} \text{d.} \quad \text{cts.} \quad \text{sons} \\ \text{But } 21542 \quad 16 \div 3 = 7180 \text{ dollars } 72 \text{ cents} \end{array}$$

INSURANCE.

Page 88.

$$\begin{array}{rcl} 2. & \begin{array}{l} \text{dolls.} \\ 1650 \\ 15\frac{1}{2} \text{ per cent.} \\ \hline 8250 \\ 1650 \\ 825 \\ \hline \$255,75 \end{array} & 3. \quad \begin{array}{l} \text{dolls.} \\ 4500 \\ 25 \text{ per cent.} \\ \hline 22500 \\ 90 \\ \hline \$1125,00 \end{array} \end{array}$$

$$5. \quad \begin{array}{l} 100 \text{ dollars} - 25 \text{ dollars} = 75 \text{ dollars.} \quad \text{Then,} \\ \text{As } \begin{array}{l} \text{dolls.} \quad \text{dolls.} \quad \text{dolls.} \\ 75 : 100 :: 4500 : \frac{450000}{75} = 6000 \end{array} \end{array}$$

$$6. \quad \begin{array}{l} 100 \text{ dolls.} - 9 \text{ dolls.} = 91 \text{ dolls.} \quad \text{Then} \\ \text{As } \begin{array}{l} \text{dolls.} \quad \text{dolls.} \quad \text{dolls.} \\ 91 : 100 : 560 : \frac{56000}{91} = 615 \quad 38\frac{2}{7} \end{array} \end{array}$$

COMMISSION.

Page 88.

2.	<i>dolls.</i> 1260 6 per cent. <hr/> \$75,60	3.	<i>dolls.</i> 2550 4 per cent. <hr/> \$102,00
4.	<i>dolls.</i> 26342 3 per cent. <hr/> \$790,26	5.	<i>dolls.</i> 6422 3 per cent. <hr/> 4) 19266 <hr/> \$48,16½

Page 89.

7. 100 dollars.
3
As $\frac{103}{100} : 100 :: 4120 : \frac{412000}{103} = 4000$ dolls

Then, as $\frac{8}{1} : 1 :: 4000 : \frac{4000}{8} = 500$ barrels

BROKAGE.

2.	<i>d. cts.</i> 1625,50 3½ per cent. <hr/> 4876,50 541,83½ <hr/> 5418,33½	3.	<i>dolls.</i> 1868 2½ per cent. <hr/> 3736 934 <hr/> \$46,70
Or, 54 dolls. 18½ cts.			

4. 560 dollars
6 per cent.

\$33,60 cents

BUYING AND SELLING STOCKS.

Page 90.

<i>dolls.</i>	<i>dolls.</i>	<i>dolls.</i>
2. 1500	Or, 1500	3. 1686
110 per ct.	$\frac{1}{10} = 150$	$\times 128$ per cent.
<hr/>	<hr/>	<hr/>
\$1650,00	\$1650	13488

3372

1686

\$2158,08

<i>dolls.</i>
4. 25000
108 per cent.
<hr/>
\$27000

<i>d.</i>	<i>d.</i>	<i>d.</i>
5. 1260	6. 9254	7. 1518
90 per cent.	84 per cent.	$83\frac{3}{4}$ per cent.
<hr/>	<hr/>	<hr/>
\$1134	\$7773,36	\$1271,32 $\frac{1}{2}$

REBATE OR DISCOUNT.

Page 91.

<i>mo.</i>	<i>d.</i>	<i>mo.</i>	<i>d.</i>	
2. As 12	: 8	:: 18	: 12	int. for the time Then,
<i>d.</i>	<i>d.</i>	<i>d.</i>	<i>d.</i>	
As 112	: 100	:: 2464	: 2200	Because $\frac{2464 \times 100}{112} = 2200$ <i>dolls.</i>

<i>mo.</i>	<i>d.</i>	<i>mo.</i>	<i>d.</i>	
3. As 12	: $5\frac{1}{2}$:: 8	: $3\frac{2}{3}$	interest for the time

<i>d.</i>	<i>d.</i>	<i>d.</i>	<i>cts.</i>	<i>d.</i>	<i>cts.</i>
Then, as $103\frac{2}{3}$: 100	:: 1857	50	: 1791	$80\frac{20}{111}$

For $\frac{185750 \times 100 \times 3}{103\frac{2}{3} \times 3}$	$= 1791$	$80\frac{20}{111}$
--	----------	--------------------

4. $(7 \times 2) + 100 = 114$	dollars
-------------------------------	---------

<i>dolls.</i>	<i>dolls.</i>	<i>dolls.</i>	
Then, as 114	: 14	:: 650	: $\frac{650 \times 14}{114} = 79$ $82\frac{26}{57}$ <i>dolls. cts.</i>

Page 91.

$$5. \text{ As } \overset{\text{mo.}}{12} : \overset{\text{mo.}}{4\frac{1}{2}} :: \overset{\text{d.}}{8} : \overset{\text{d.}}{3} = \text{a rate for the time}$$

$$\text{Then, as } \overset{\text{dolls.}}{103} : \overset{\text{dolls.}}{100} :: \overset{\text{dolls.}}{5150} : \frac{5150 \times 100}{103} = \overset{\text{dolls.}}{5000} \text{ p. w.}$$

Again,

$$\text{As } 100 : 99 (=100-1) :: \overset{\text{dolls.}}{5000} : \overset{\text{dolls.}}{4950}$$

Page 92. Note 1st.

$$3. \text{ As } \overset{\text{mo.}}{12} : \overset{\text{mo.}}{18} :: \overset{\text{dolls.}}{8} : \overset{\text{dolls.}}{12} \text{ rate for the time}$$

$$\text{Then, as } \overset{\text{dolls.}}{112} : \overset{\text{dolls.}}{12} :: \overset{\text{dolls.}}{7280} : \overset{\text{dolls.}}{780} \text{ the discount}$$

$$\text{Again, } \overset{\text{dolls.}}{7280} \times \overset{\text{mo.}}{9} = \overset{\text{cents.}}{65520} \text{ interest at 6 per cent.}$$

$$\frac{1}{2} = 21840 \text{ interest at 2 ' '}$$

$$\begin{array}{r} \$873,60 \text{ interest at 8 per cent.} \\ \text{Subtract } \$780,00 \text{ discount} \end{array}$$

$$\text{Difference } \$ 93,60$$

Note 2d.

$$2. \quad \overset{\text{dolls.}}{1650} \times \overset{\text{cts.}}{3} = 4950 = 49 \text{ dollars } 50 \text{ cents.}$$

$$3. \quad 2464 \text{ dollars} \times 8 = 19712 \text{ cents discount}$$

$$\text{But } 2464 \text{ dollars} - 19712 \text{ cents} = 2266 \text{ dollars } 88 \text{ cents}$$

BANK DISCOUNT.

Page 93.

$$2. \quad \frac{\overset{\text{days}}{(30+4)} \times \overset{\text{dolls.}}{250}}{60} = 1 \text{ dollar } 41\frac{2}{3} \text{ cents}$$

$$\text{Or, } \frac{17 \times 250}{30} = 1 \text{ dollar } 41\frac{2}{3} \text{ cents}$$

$$3. \quad \frac{\overset{\text{days}}{(90+4)} \times \overset{\text{dolls.}}{600}}{60} = 9 \text{ dollars } 40 \text{ cents}$$

$$\text{Or, } \frac{47 \text{ days} \times 600 \text{ dolls.}}{30} = 9 \text{ dollars } 40 \text{ cents}$$

Page 93.

$$4. \quad \frac{\begin{array}{c} \text{days} \\ (60+4) \end{array} \times \begin{array}{c} \text{dolls. cts.} \\ 1260 \ 40 \end{array}}{60} = 13 \text{ dollars } 44\frac{32}{75} \text{ cents.}$$

$$\text{Or, } \frac{32 \times 1260 \ 40}{30} = 13 \text{ dollars } 44\frac{32}{75} \text{ cents.}$$

$$5. \quad \frac{\begin{array}{c} \text{days} \\ (60+4) \end{array} \times \begin{array}{c} \text{dolls. cts.} \\ 2649 \ 75 \end{array}}{60} = 28 \text{ dollars } 26 \text{ cents } 4 \text{ mills}$$

$$\text{Or, } \frac{32 \times 2649 \ 75}{30} = 28 \text{ dollars } 26 \text{ cents } 4 \text{ mills}$$

EQUATION OF PAYMENTS.

Page 94.

$$2. \quad \begin{array}{l} \text{dolls. mo.} \\ 500 \times 2 = 1000 \\ 1000 \times 5 = 5000 \\ 1500 \times 8 = 12000 \end{array}$$

$$3. \quad \begin{array}{l} \text{dolls. mo.} \\ 200 \times 5 = 1000 \\ 300 \times 8 = 2400 \\ 500 \times 10 = 5000 \end{array}$$

$$\begin{array}{r} 3000 \) \quad 18000 \ (6 \text{ mo.} \\ \underline{18000} \end{array} \quad \begin{array}{r} 1000 \) \quad 8400 \ (8 \ 12 \text{ mo. da.} \\ \underline{8400} \end{array}$$

$$4. \quad 1400 \text{ dollars} - 1000 \text{ dollars} = 400 \text{ dollars}$$

$$\text{Then, as } \begin{array}{c} d. \\ 400 \end{array} : \begin{array}{c} d. \\ 1000 \end{array} :: \begin{array}{c} mo. \\ 1 \end{array} : 2\frac{1}{2} \text{ months}$$

SINGLE FELLOWSHIP.

Page 95.

$$2. \quad \begin{array}{c} d. \\ A \ 7500 \end{array} + \begin{array}{c} d. \\ B \ 6000 \end{array} + \begin{array}{c} d. \\ C \ 4500 \end{array} = 18000, \text{ Then,}$$

$$\text{As } \begin{array}{c} \text{dolls.} \\ 18000 \end{array} : \begin{array}{c} \text{dolls.} \\ 5400 \end{array} \text{ or } 10 : 3 :: \left\{ \begin{array}{l} \begin{array}{c} \text{dolls.} \\ 7500 \end{array} : \begin{array}{c} \text{dolls.} \\ 2250 \end{array} \text{ A's gain} \\ \begin{array}{c} \text{dolls.} \\ 6000 \end{array} : \begin{array}{c} \text{dolls.} \\ 1800 \end{array} \text{ B's ' } \\ \begin{array}{c} \text{dolls.} \\ 4500 \end{array} : \begin{array}{c} \text{dolls.} \\ 1350 \end{array} \text{ C's ' } \end{array} \right\}$$

$$3. \quad \begin{array}{c} d. \\ A \ 1291 \end{array} \begin{array}{c} cts. \\ 23 \end{array} + \begin{array}{c} d. \\ B \ 500 \end{array} \begin{array}{c} cts. \\ 37 \end{array} + \begin{array}{c} d. \\ C \ 709 \end{array} \begin{array}{c} cts. \\ 40 \end{array} + 228 = 2729$$

$$\text{Now, as } \begin{array}{c} d. \\ 2729 \end{array} : \begin{array}{c} d. \\ 2046 \end{array} \begin{array}{c} cts. \\ 75 \end{array} :: \begin{array}{c} d. \\ 100 \end{array} : \begin{array}{c} d. \\ 75 \end{array}$$

$$\text{Then, as } 100 : 75 :: \left\{ \begin{array}{l} \begin{array}{c} d. \ cts. \\ 1291 \ 23 \end{array} : \begin{array}{c} d. \ cts. \\ 968 \ 42\frac{1}{2} \end{array} \\ \begin{array}{c} d. \ cts. \\ 500 \ 37 \end{array} : \begin{array}{c} d. \ cts. \\ 375 \ 27\frac{1}{2} \end{array} \\ \begin{array}{c} d. \ cts. \\ 709 \ 40 \end{array} : \begin{array}{c} d. \ cts. \\ 532 \ 05 \end{array} \end{array} \right\}$$

$$\text{Or, } 4 : 3 :: \left\{ \begin{array}{l} \begin{array}{c} d. \ cts. \\ 1291 \ 23 \end{array} : \begin{array}{c} d. \ cts. \\ 968 \ 42\frac{1}{2} \end{array} \\ \begin{array}{c} d. \ cts. \\ 500 \ 37 \end{array} : \begin{array}{c} d. \ cts. \\ 375 \ 27\frac{1}{2} \end{array} \\ \begin{array}{c} d. \ cts. \\ 709 \ 40 \end{array} : \begin{array}{c} d. \ cts. \\ 532 \ 05 \end{array} \end{array} \right\}$$

Page 95.

	<i>dolls.</i>	<i>A.</i>	<i>R.</i>	<i>P.</i>	<i>dolls.</i>	<i>A.</i>	<i>R.</i>	<i>P.</i>
4. As	600	:	585	2 34 ::	(180 : 175 2 34 $\frac{1}{5}$)			
					(195 : 190 1 17 $\frac{1}{20}$)			
					(225 : 219 2 22 $\frac{3}{4}$)			

Page 96.

	<i>bbl.</i>	<i>bbl.</i>		<i>barrels</i>
5. As	2160	:	900 :: 12 : 5 ::	(960 : 400)
				(720 : 300)
				(480 : 200)

	<i>dolls.</i>	<i>d.</i>	<i>d.</i>		<i>dolls.</i>	<i>d.</i>	<i>d.</i>
6. A	1260	+	B 840	=	2100,	And	825—275=550

	<i>d.</i>	<i>d.</i>	<i>d.</i>	<i>d.</i>	<i>d.</i>
Now, as	2100	:	550 ::	(1260 : 330 A's gain)	
				(840 : 220 B's ')	

	<i>B's gain.</i>	<i>B's stock.</i>		<i>d.</i>	<i>d.</i>
And, as	220	:	840 :: 11 : 42 ::	275	: 1050 C's stock.

	<i>dolls.</i>	<i>dolls.</i>	<i>dolls.</i>
7. (800×2)+40=1640 whole gain, And			

	<i>d.</i>	<i>d.</i>	<i>d.</i>	<i>d.</i>
A's	140	+	B's 260	+
C's	300	=	700	

Then, 800 dollars—700 dollars=100 dollars D's stock.

	<i>dolls.</i>	<i>dolls.</i>		<i>dolls.</i>	<i>dolls.</i>
Now, as	800	:	1640 :: 20 : 41 ::	(140 : 287 A's gain)	
				(260 : 533 B's ')	
				(300 : 615 C's ')	
				(100 : 205 D's ')	

8.		<i>d.</i>	<i>cts.</i>
	<i>cattle dolls.</i>	(80 : 25 60 A pays)	
As	300	:	96 :: 25 : 8 ::
			(100 : 32 00 B ')
			(120 : 38 40 C ')

9. First 2+3+5=10 dollars, Then

	<i>dolls.</i>	<i>dolls.</i>		<i>dolls.</i>
As	10	:	5000 :: 1 : 500 ::	(2 : 1000 A gets)
				(3 : 1500 B ')
				(5 : 2500 C ')

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10. 20 dollars + 85 dollars = 105 dollars whole stock

$$\begin{array}{cccc} d. & d. & d. & d. \\ \text{Now, as } 105 : 63 :: 20 : 12 & \text{A's gain} \end{array}$$

$$\begin{array}{cccc} d. & d. & d. & d. \\ \text{And } 63 - (21 + 12) = 63 - 33 = 30 & \text{C's gain} \end{array}$$

$$\begin{array}{ccc} & \text{dolls.} & \text{dolls.} \\ \text{Then, as } 12 : 20 :: & \left\{ \begin{array}{l} 21 : 35 \text{ B put in} \\ 30 : 50 \text{ C put in} \end{array} \right. \end{array}$$

COMPOUND FELLOWSHIP.

Page 97.

$$\begin{array}{r} d. \quad mo. \\ 2. \quad 600 \times 8 = 4800 \\ \quad 200 \\ \hline \end{array}$$

$$800 \times 8 = 6400$$

A 11200

$$\begin{array}{r} 1000 \times 12 = 12000 \\ \quad 800 \\ \hline \end{array}$$

$$1800 \times 4 = 7200$$

C 19200

$$\begin{array}{r} d. \quad mo. \\ 1200 \times 10 = 12000 \\ \quad 600 \\ \hline \end{array}$$

$$600 \times 6 = 3600$$

B 15600

$$\begin{array}{r} 11200 \text{ A} \\ 15600 \text{ B} \\ 19200 \text{ C} \\ \hline \end{array}$$

46000

$$\begin{array}{l} \text{Now, as } 46000 : 2300 :: \left\{ \begin{array}{l} 11200 : 560 \text{ dolls. A's share} \\ 15600 : 780 \text{ dolls. B's '} \\ 19200 : 960 \text{ dolls. C's '} \end{array} \right. \\ \text{Or } 20 : 1 \end{array}$$

$$\begin{array}{ccc} mo. & mo. & dolls. & dolls. \\ 3. \quad \text{As } 9 : 12 :: 600 : 800 \end{array}$$

Page 98.

$$\begin{array}{ccc} mo. & mo. & d. \\ 4. \quad \text{As } 8 : 12 :: 1800 : 2700 \text{ dollars} \end{array}$$

$$\begin{array}{cccc} mi. & mi. & mi. & mi. \\ 5. \quad \text{A } 600 + \text{B } 600 + \text{C } 300 + \text{D } 100 = 1600 \text{ miles} \end{array}$$

$$\begin{array}{l} \text{miles} \quad \text{dolls.} \\ \text{As } 1600 : 160 :: 10 : 1 :: \left\{ \begin{array}{l} 600 : 60 \text{ dolls. A pays} \\ 600 : 60 \text{ ' B '} \\ 300 : 30 \text{ ' C '} \\ 100 : 10 \text{ ' D '} \end{array} \right. \end{array}$$

Page 98.

$$\begin{array}{rcl}
 6. & 5 \text{ oxen} \times 4\frac{1}{2} \text{ months} & = 22\frac{1}{2} \\
 & 8 \quad \times 5 & = 40 \\
 & 9 \quad \times 6\frac{1}{2} & = 58\frac{1}{2}
 \end{array}$$

Sum 121

$$\begin{array}{rcl}
 & d. & cts. \\
 \text{Now, as } 121 : 145 \text{ } 20 :: & \left\{ \begin{array}{l} 22\frac{1}{2} : 27 \\ 40 : 48 \\ 58\frac{1}{2} : 70 \end{array} \right. & \begin{array}{l} A \text{ pays} \\ B \text{ ' } \\ C \text{ ' } \end{array}
 \end{array}$$

$$\begin{array}{rcl}
 7. & 4000 \text{ dollars} \times 12 \text{ months} & = 48000 \\
 & 3000 \text{ ' } \times 15 \text{ ' } & = 45000 \\
 & 5000 \text{ ' } \times 8 \text{ ' } & = 40000
 \end{array}$$

133000

$$\begin{array}{rcl}
 & d. & \\
 \text{As } 133000 : 665 :: & \left\{ \begin{array}{l} 48000 : 240 \text{ dolls. A's part} \\ 45000 : 225 \text{ ' B's ' } \\ 40000 : 200 \text{ ' C's ' } \end{array} \right. & \\
 \text{Or, } 200 : 1 & &
 \end{array}$$

$$\begin{array}{rcl}
 8. & 580 \text{ dollars} \times 6\frac{1}{2} \text{ months} & = 3770 \\
 & 580 \text{ ' } \times 9\frac{1}{2} \text{ ' } & = 5510 \\
 & 870 \text{ ' } \times 8\frac{2}{3} \text{ ' } & = 7540
 \end{array}$$

16820

$$\begin{array}{rcl}
 & d. & cts. \\
 \text{As } 16820 : 263 \text{ } 90 :: & \left\{ \begin{array}{l} 3770 : 59d. \text{ } 15c. \text{ A lost} \\ 5510 : 86 \text{ } 45 \text{ B ' } \\ 7540 : 118 \text{ } 30 \text{ C ' } \end{array} \right. &
 \end{array}$$

PROFIT AND LOSS.

Page 99.

$$\begin{array}{rcl}
 2. & 150 \text{ cents, sold for} & \\
 & 120 \text{ cents, cost} & \\
 \hline
 & 30 \text{ cents, gain on 120 cents} &
 \end{array}$$

$$\begin{array}{rcl}
 & cts. & cts. \\
 \text{Then, as } 120 : 30 :: & 100 : 25 \text{ per cent.} &
 \end{array}$$

$$\begin{array}{rcl}
 & yd. & cts. \\
 3. & \text{As } 1 : 66 :: 42 : 27 \text{ } 72 \text{ sold for} & \\
 & \text{Subtract } 21 \text{ } 00 \text{ cost} &
 \end{array}$$

Rem. \$ 6 72 gain

Page 99.

4. 32 galls. \times 6 barrels = 192 gallons, bought
 Subtract 12 gallons leaked out

Rem. 180 gallons

And 96 dollars + 12 dollars = 108 dollars sold for

galls. d. gal. cts.
 Then, as 192 : 96 :: 1 : 50 cost per gallon

g. d. g. cts.
 And, as 180 : 108 :: 1 : 60 sold for per gallon

5. 20 cents—17 cents = 3 cents, loss on each knife

knife cts. knives doz. d. cts.
 As 1 : 3 :: 1440 (=120) : 43 20

Page 100.

6. 149 dollars

7. 100 dollars

51 "

18 "

yds. — yd. d.
 As 100 : \$200 :: 1 : 2

d. — cts. d. c. ms.
 As 100 : \$82 :: 125 : 1 02 5

- d. d. cts.*
 8. As 100 : 120 :: 90 : 1 08 must sell for
 108 cts.—90 cts. = 18 cts. gain per hat

hat cts. hats doz. d. cts.
 Now, as 1 : 18 :: 240 (=20) : 43 20

9. 115 gallons \times 110 cents = 126 50 cost

Add 5 00

\$131 50 must sell for

But, as 1 doll. : 1 gall. :: 131 dolls. 50 cts. : 131½ galls.
 the number of gallons that must be sold. Consequently 131½
 gallons—115 gallons = 16½ gallons of water.

- dolls. cts.*
 10. *lb. cwt. cts.* 134 40 cost
 448 (=4) \times 25 = 112 00 sold for

\$22 40 whole loss

lb. dolls. cts. lb.
 Then, as 448 : 22 40 :: 1 : 5 cents per lb.

Page 100.

11. As 120 : 100 :: 1728 : 1440 whole cost
 dolls. dolls.
 yards *dolls.* yd.

Then, as 360 : 1440 :: 1 : 4 dollars

12. \$4 90—\$4=90 cents; Then,

dolls. cts. dolls. dolls.
 As 4 : 90 :: 1000 : 225

13. As 120 : 1 :: 150 : 1 25 per bushel
 d. d. cts. bu. d. cts.

Now, as 1 25 : 1 :: 37 50 : 30 bushels

14. 5000 galls. at 48 cents=2400 dollars

Interest for 2 months = 32 ‘

Costs \$2432 to pay cash
 5000 galls. at 50 cents=\$2500 in two months

Diff. \$ 68 gained by borrowing
 the money and paying the cash.

15. *head dolls. dolls.*
 12) 240 (20 the cost per head

cts. lb. dolls. lb. C. qr. lb.
 Then, as 4 : 1 :: 20 : 500=4 1 24

BARTER.

Page 101.

2. 320 bushels × \$1 20=\$384

Subtract 160 cash

\$224

cts. lb.
 Then, as 20 : 1 :: 224 dollars : 1120 lb.

3. *cts. cts. bu.*
 As 70 : 125 :: 28 : 50 bushels

4. *cts. cts. m. cts.*
 As 250 : 319 :: 23½ : 29 9⅔, or 30 nearly

5. *d. cts. d. cts.*
 As 100 : 120 :: 1 25 : 1 50

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$$6. \text{ As } \begin{matrix} d. & cts. \\ 2 & 50 \end{matrix} : \begin{matrix} d. & cts. \\ 2 & 80 \end{matrix} :: \begin{matrix} d. & cts. \\ 1 & 20 \end{matrix} : \frac{2,80 \times 1,20}{2,50} = \begin{matrix} d. & cts. & ms. \\ 1 & 34 & 4 \end{matrix}$$

$$7. \text{ As } \begin{matrix} cts. & cts. \\ 99 & 90 \end{matrix} :: \begin{matrix} bu. \\ 240 \end{matrix} : 218 \frac{2}{11} \text{ bushels}$$

$$\text{And, as } \begin{matrix} cts. & cts. \\ 90 & 95 \end{matrix} :: \begin{matrix} cts. & d. & cts. \\ 99 & 1 & 04 \end{matrix} 5 \text{ mills}$$

$$8. \text{ As } \begin{matrix} oz. & d. & cts. \\ 16 & 1 & 28 \end{matrix} :: \begin{matrix} oz. & lb. & oz. \\ 420 & (=26 & 4) \end{matrix} : 33 \text{ dolls. } 60 \text{ cts.}$$

$$\text{Then, as } \begin{matrix} cts. & lb. \\ 6 & 1 \end{matrix} :: \begin{matrix} d. & cts. & lb. \\ 33 & 60 & 560 \end{matrix} = 5 \text{ cwt.}$$

$$9. \text{ As } \begin{matrix} cts. & cts. \\ 22 & 3 \end{matrix} (=25-22) :: 100 : 13 \frac{7}{11}$$

$$\text{And } 13 \frac{7}{11} + 10 = 23 \frac{7}{11}$$

$$\text{Then, as } 100 : 123 \frac{7}{11} :: 28 : 34 \frac{34}{55} \text{ cents}$$

$$10. \text{ 250 barrels} \times 6 \text{ dolls. } 25 \text{ cts.} = 1562 \text{ dolls. } 50 \text{ cts.}$$

$$\begin{array}{rcl} lb. & cwt. & cts. \text{ dolls. cts.} \\ \text{And } 448 (=4) \text{ at } 30 & = & 134 \text{ } 40 \\ 64 \text{ lb. at } \$1 & 75 & = 112 \text{ } 00 \\ 25 \text{ y. at } \$6 & & = 150 \text{ } 00 \\ \text{Cash} & 206 & 10 \\ \hline & & \$602 \text{ } 50 \end{array}$$

$$\text{But } \begin{matrix} dolls. & cts. & dolls. & cts. \\ 1562 & 50 & -602 & 50 \end{matrix} = 960 \quad \text{Then, as } \begin{matrix} d. & bbl. & d. & bbl. \\ 8 & 1 & :: & 960 & 120 \end{matrix}$$

EXCHANGE.

Case 1. Page 104.

$$2. \text{ As } \begin{matrix} d. & s. & d. & s. & d. \\ 96 & (=8) & : & 90 & (=7 \text{ } 6) \end{matrix} :: \begin{matrix} £. & £. \\ 256 & : & 240 \end{matrix}$$

$$\text{Or, } £256$$

$$\frac{1}{16} = 16 \text{ subtract}$$

$$\hline \$240$$

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$$3. \quad \begin{array}{ccccccc} d. & s. & d. & s. & d. & L. & L. & s. & d. \\ \text{As } 90 & (=7 \ 6) & : & 56 & (=4 \ 8) & :: & 1500 & : & 933 \ 6 \ 8 \end{array}$$

$$\text{Or, } \frac{\text{£}1500 \times 3\frac{1}{9}}{5} = \text{£}933 \ 6 \ 8 \quad \text{Answer as before}$$

$$4. \quad \begin{array}{ccccccc} s. & s. & \text{£.} & \text{£.} & & & \\ \text{As } 6 & : & 8 & :: & 180 & : & 240 \end{array} \quad \text{Or, } \begin{array}{r} \text{£}180 \\ \frac{1}{3} = 60 \\ \hline \text{£}240 \text{ as before} \end{array}$$

$$5. \quad \begin{array}{ccccccc} d. & s. & d. & s. & \text{£.} & \text{£.} & \\ \text{As } 56 & (=4 \ 8) & : & 72 & (=6) & :: & 280 & : & 360 \end{array}$$

$$\text{Or, } \begin{array}{r} \text{£}280 \\ \frac{2}{7} = 80 \text{ add} \\ \hline \text{£}360 \text{ as before} \end{array}$$

$$6. \quad \begin{array}{ccccccc} d. & s. & d. & s. & \text{£.} & \text{£.} & s. & d. \\ \text{As } 72 & (=6) & : & 56 & (=4 \ 8) & :: & 304 & : & 236 \ 8 \ 10\frac{2}{3} \end{array}$$

$$\text{Or, } \begin{array}{r} 304 \\ \frac{1}{9} = 33 \ 15 \ 6\frac{2}{3} \\ \hline \end{array}$$

$$\begin{array}{r} 270 \ 4 \ 5\frac{1}{4} \\ 33 \ 15 \ 6\frac{2}{3} \\ \hline \end{array}$$

$$\text{£}236 \ 8 \ 10\frac{2}{3}$$

Case 2. Page 105.

$$4. \quad \begin{array}{ccccccc} \text{£.} & s. & d. & \text{shillings} & & s. & s. & \text{dolls.} & \text{cts.} \\ \text{468 } 19 \ 6 = & 9379,5 & \text{Then, } & 9379,5 \div 6 = & 1563 \ 25 \end{array}$$

$$5. \quad \begin{array}{ccccccc} \text{£.} & s. & \text{pence} & & d. & d. & \text{dolls.} & \text{cts.} \\ \text{750 } 10 = & 180120 & \text{Then, } & 180120 \div 90 = & 2001 \ 33\frac{1}{3} \end{array}$$

Case 3. Page 108.

$$5. \quad \begin{array}{ccccccc} \text{£.} & s. & \text{£.} & & & & \\ \text{540 } 15 = & 540,75 & \text{Then, } & \text{£}540,75 \times \$4,10 = & \$2217 \ 07\frac{1}{2} \end{array}$$

$$6. \quad \begin{array}{ccccccc} 2217 \text{ dolls. } 07 \text{ cts. } 5 \text{ ms.} & & \text{£} & & \text{£} & & s. \\ \hline 4 \text{ dolls. } 10 \text{ cts.} & = & 540,75 & = & 540 & 15 \end{array}$$

Page 108.

	<i>£.</i>	<i>d.</i>	<i>cts.</i>	<i>d.</i>	<i>cts.</i>
7. 320×4	44	=	1420	80	at par
$12\frac{1}{2}$ is $\frac{1}{8}$	=	177	60	add	
	<hr/>		<hr/>		
	\$1598		40		

Page 109.

8. $\$3259 \div \$4 \ 10 = \text{£}794,878$, Then,

As $108 : 100 :: 794,878 \text{ } \overset{\text{£.}}{\text{}} : 735,9999$, or $736 \overset{\text{£.}}{\text{}}$ nearly

Otherwise,

$\frac{\$3259 \times 100}{\$4,10 \times 108} = 735\frac{1105}{1107} = 735 \ 19 \ 11\frac{1}{2} \ \frac{98}{369}$, or 736 nearly.

ALLIGATION.

Case 1.

2.	20 lbs. at 10 cents	=	200
	30 " at 15 "	=	450
	40 " at 25 "	=	1000
	90		cts. 1650

lb. cts. lb. cts.
Now, as $90 : 1650 :: 1 : 18\frac{1}{3}$

3.	10 bushels at 150 cents	=	1500
	20 " at 160 "	=	3200
	30 " at 170 "	=	5100
	60		9800

bu. cts. bu. cts.
Now, as $60 : 9800 :: 1 : 163\frac{1}{3}$

Page 110.

4.	4 ounces at 75 cents	=	300
	8 " at 60 "	=	480
	12		780

oz. cts. oz. cts.
Now, as $12 : 780 :: 1 : 65$

Case 2. Page 110.

$$2. \quad 4 \left\{ \begin{array}{l} 3 \\ 5 \\ 6 \end{array} \right\} \begin{array}{l} 1+2=3 \text{ gallons at 3 dollars} \\ 1 = 1 \quad \text{' at 5 ' } \\ 1 = 1 \quad \text{' at 6 ' } \end{array}$$

$$3. \quad 25 \left\{ \begin{array}{l} 40 \\ 30 \\ 20 \end{array} \right\} \begin{array}{l} 5 \text{ Or, } 1 \\ 5 \text{ Or, } 1 \\ 4 \end{array} \begin{array}{l} 6 \text{ bushels of rye} \\ 6 \text{ ' of corn} \\ 24 \text{ ' of oats} \end{array}$$

$15+5=20$

$$4. \quad 1st. \left\{ \begin{array}{l} 120 \\ 110 \\ 90 \\ 80 \end{array} \right\} \begin{array}{l} 20 \text{ at } 120 \\ 10 \quad 110 \\ 10 \quad 90 \\ 20 \quad 80 \end{array} \quad 2d. \left\{ \begin{array}{l} 120 \\ 110 \\ 90 \\ 80 \end{array} \right\} \begin{array}{l} 10+20=30 \text{ at } 120 \\ =20 \quad 110 \\ =20 \quad 90 \\ 20+10=30 \quad 80 \end{array}$$

$$3d. \left\{ \begin{array}{l} 120 \\ 110 \\ 90 \\ 80 \end{array} \right\} \begin{array}{l} 10 \text{ at } 120 \\ 20 \quad 110 \\ 20 \quad 90 \\ 10 \quad 80 \end{array} \quad 4th. \left\{ \begin{array}{l} 120 \\ 110 \\ 90 \\ 80 \end{array} \right\} \begin{array}{l} =10 \text{ at } 120 \\ 10+20=30 \quad 110 \\ 20+10=30 \quad 90 \\ =10 \quad 80 \end{array}$$

$$5th. \left\{ \begin{array}{l} 120 \\ 110 \\ 90 \\ 80 \end{array} \right\} \begin{array}{l} 10+20=30 \text{ at } 120 \text{ cents} \\ =10 \quad 110 \\ 20+10=30 \quad 90 \\ =20 \quad 80 \end{array}$$

$$6th. \left\{ \begin{array}{l} 120 \\ 110 \\ 90 \\ 80 \end{array} \right\} \begin{array}{l} =20 \text{ at } 120 \text{ cents} \\ 10+20=30 \quad 110 \\ =10 \quad 90 \\ 20+10=30 \quad 80 \end{array}$$

$$7th. \left\{ \begin{array}{l} 120 \\ 110 \\ 90 \\ 80 \end{array} \right\} \begin{array}{l} 10+20=30 \text{ at } 120 \text{ cents} \\ 10+20=30 \quad 110 \\ 20+10=30 \quad 90 \\ 20+10=30 \quad 80 \end{array}$$

Case 3. Page 112.

$$2. \quad 22 \left\{ \begin{array}{l} 48 \\ 36 \\ 30 \\ 18 \end{array} \right\} \begin{array}{l} = 4 \\ = 4 \\ = 4 \\ 26+14+8=48 \text{ given,} \end{array}$$

Now, as $48 : 24bu :: 4 : 2$ bushels of each sort.

Page 112.

3.

	0	= 2	
22	{	16	= 2
		18	= 2 quantity given
		20	= 2
		24	= 2
		22+6+4+2=34	

Now, as $2 : 10 :: \begin{cases} 2 : 10 \text{ lb. of alloy} \\ 2 : 10 \text{ of 16 carats fine} \\ 2 : 10 \text{ of 20 ' ' } \\ 34 : 170 \text{ of 24 ' ' } \end{cases}$

Case 4.

$$2. \quad 20 \left\{ \begin{array}{l} 15 \\ 17 \\ 18 \\ 22 \end{array} \right\} \left. \vphantom{\begin{array}{l} 15 \\ 17 \\ 18 \\ 22 \end{array}} \right) 5+3+2=10$$

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[illegible]

3. $\begin{array}{r} 5 \begin{array}{l} (6)5 \\ (0)1 \end{array} \end{array}$ Then, as $6 : 70 :: \begin{array}{l} 5 : 58\frac{1}{2} \text{ galls. of wine} \\ 1 : 11\frac{2}{3} \text{ galls. of water} \end{array}$

REDUCTION OF VULGAR FRACTIONS.

Case 1. Page 114.

$$2. \quad \frac{144}{144} \cdot 216 \left(\frac{1}{144} \right) \quad \text{Now, } 72 \cdot \frac{144}{216} \left(= \frac{2}{3} \right)$$

com. measure $\frac{72}{144} = \frac{1}{2}$ Or, $\frac{(8)}{144} = \frac{(9)}{18} = \frac{2}{3}$ as before

3. $75 \mid 125 \left(\frac{1}{75} \right)$ Then, $25 \mid \frac{75}{125} \left(= \frac{3}{5} \right)$

$$\begin{array}{r} 50 \mid 75 \mid 1 \\ - 50 \\ \hline \text{com. measure } 25 \mid 50 \mid 2 \end{array}$$

$$\text{Or, } \frac{75}{125} = \frac{15}{25} = \frac{3}{5} \text{ as before}$$

Page 114.

$$\begin{array}{rcl}
 4. & 4800 \) \ 10800 \ (\ 2 & \text{Then, } 1200 \) \ \frac{4800}{10800} (= \frac{4}{9}) \\
 & \underline{9600} & \\
 & \text{com. measure } 1200 \) \ 4800 \ (\ 4 & \text{Or, } \frac{(12)}{108} \mid \frac{00}{00} = \frac{4}{9} \text{ as before} \\
 & \underline{4800} &
 \end{array}$$

$$\begin{array}{rcl}
 5. & 91 \) \ 117 \ (\ 1 & \\
 & \underline{91} & \\
 & 26 \) \ 91 \ (\ 3 & \text{Then, } 13 \) \ \frac{91}{117} (= \frac{7}{9}) \\
 & \underline{78} & \\
 & \text{com. measure } 13 \) \ 26 \ (\ 2 & \\
 & \underline{26} &
 \end{array}$$

$$\begin{array}{rcl}
 6. & 9876 \) \ 88884 \ (\ 9 & \text{Therefore, } 9876 \) \ \frac{9876}{88884} = \frac{1}{9} \\
 & \underline{88884} &
 \end{array}$$

Case 2. Page 115.

$$\begin{array}{lcl}
 2. & \frac{12 \times 17 + 15}{17} = \frac{219}{17} & \text{fraction required} \\
 3. & \frac{183 \times 21 + 5}{21} = \frac{3848}{21} & \text{fraction required} \\
 4. & \frac{514 \times 16 + 5}{16} = \frac{8229}{16} & \text{fraction required} \\
 5. & \frac{68425 \times 4 + 3}{4} = \frac{273703}{4} & \text{fraction required}
 \end{array}$$

Case 3.

$$\begin{array}{lcl}
 2. & 3848 \div 21 = 183 \frac{5}{21} & \text{equivalent mixed number} \\
 3. & 2465 \div 7 = 352 \frac{1}{7} & \text{equivalent mixed number} \\
 4. & 961 \div 17 = 56 \frac{9}{17} & \text{equivalent mixed number} \\
 5. & 8229 \div 16 = 514 \frac{5}{16} & \text{equivalent mixed number}
 \end{array}$$

Case 4. Page 116.

$$\begin{array}{lcl}
 2. & 3 \times 5 \times 6 = 90 & \text{first numerator} \\
 & 4 \times 4 \times 6 = 96 & \text{second numerator} \\
 & 5 \times 4 \times 5 = 100 & \text{third numerator}
 \end{array}$$

And $4 \times 5 \times 6 = 120$ common denominatorTherefore, $\frac{90}{120}$, $\frac{96}{120}$ and $\frac{100}{120}$, are the fractions required

Page 116.

3. $1 \times 5 \times 15 \times 9 = 675$ first numerator

$3 \times 3 \times 15 \times 9 = 1215$ second

$4 \times 3 \times 5 \times 9 = 540$ third

$5 \times 3 \times 5 \times 15 = 1125$ fourth

And $3 \times 5 \times 15 \times 9 = 2025$ common denominator

Therefore, $\frac{675}{2025}$, $\frac{1215}{2025}$, $\frac{540}{2025}$ and $\frac{1125}{2025}$ are the frac. required

Case 5.

2. $4 \overline{) 3 \ 8 \ 12 \ 20}$

$3 \overline{) 3 \ 2 \ 3 \ 5}$

$1 \ 2 \ 1 \ 5$

Now, $4 \times 3 \times 2 \times 5 = 120$ common denominator

Then, 120 com. denominator

Divisors $\left\{ \begin{array}{l|l} 3 & 40 \times 2 = 80 \\ 8 & 15 \times 3 = 45 \\ 12 & 10 \times 4 = 40 \\ 20 & 6 \times 5 = 30 \end{array} \right\}$ New numerators

Hence, $\frac{80}{120}$, $\frac{45}{120}$, $\frac{40}{120}$ and $\frac{30}{120}$

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3. $3 \overline{) 3 \ 5 \ 15 \ 9}$

$5 \overline{) 1 \ 5 \ 5 \ 3}$

$1 \ 1 \ 1 \ 3$

Now, $3 \times 5 \times 3 = 45$ common denominator

Then, 45 com. denominator

Divisors $\left\{ \begin{array}{l|l} 3 & 15 \times 1 = 15 \\ 5 & 9 \times 3 = 27 \\ 15 & 3 \times 4 = 12 \\ 9 & 5 \times 5 = 25 \end{array} \right\}$ New numerators

Hence, $\frac{15}{45}$, $\frac{27}{45}$, $\frac{12}{45}$, and $\frac{25}{45}$

Case 6.

2. $7 \times 4 \times 9 = 252$ num.

$8 \times 6 \times 10 = 480$ denom.

Or, 3

$7 \times 4 \times \cancel{9}$

7×3

$\frac{\cancel{8} \ \cancel{6} \ 10 \ 2 \times 2 \times 10}{2 \ 2} = \frac{21}{40}$

Hence, $\frac{252}{480} = \frac{21}{40}$

Page 117.

$$3. \quad 5 \times 4 \times 3 = 60 \text{ num.} \quad 9 \times 8 \times 4 = 288 \text{ denom.} \quad \text{Or, } \frac{5 \times \cancel{4} \times \cancel{3}}{\cancel{8} \cancel{3} 4} = \frac{5}{3 \times 2 \times 4} = \frac{5}{24}$$

Hence, $\frac{60}{288} = \frac{5}{24}$

$$4. \quad 5 \times 4 \times 11 = 220 \text{ num.} \quad 9 \times 7 \times 12 = 756 \text{ denom.} \quad \text{Or, } \frac{5 \times \cancel{4} \times 11}{9 \ 7 \ \cancel{12}} = \frac{5 \times 11}{9 \times 7 \times 3} = \frac{55}{189}$$

Hence, $\frac{220}{756} = \frac{55}{189}$

Case 7.

$$2. \quad \frac{4 \times 1 \times 1}{5 \times 20 \times 12} = \frac{1}{1200} = \frac{1}{300} \text{ fraction required}$$

$$3. \quad \frac{\cancel{8} \times 1 \times 1}{13 \times 8 \times \cancel{8}} = \frac{1}{13 \times 8 \times 7} = \frac{1}{728}$$

Page 118.

$$4. \quad \frac{\cancel{11} \times 1 \times 1}{11 \times \cancel{6} \times 24} = \frac{1}{11 \times 6 \times 24} = \frac{1}{1584}$$

Case 8.

$$2. \quad \frac{1 \times 12 \times 20}{300 \times 1 \times 1} = \frac{240}{300} = \frac{4}{5} \text{ fraction required}$$

$$3. \quad \frac{1 \times 63 \times 8}{728 \times 1 \times 1} = \frac{504}{728} = \frac{9}{13} \text{ fraction required}$$

$$4. \quad \frac{1 \times 24 \times 60}{1584 \times 1 \times 1} = \frac{1440}{1584} = \frac{10}{11} \text{ fraction required}$$

Case 9.

$$2. \quad \begin{array}{r} 12 \text{ ounces} \\ 3 \end{array} = 1 \text{ pound}$$

$$5 \) \ 36$$

7 ounces 4 pennyweights

Page 119.

$$3. \quad \begin{array}{r} 8 \text{ furlongs} \\ 4 \end{array} = 1 \text{ mile} \quad 4. \quad \begin{array}{r} 24 \text{ hours} \\ 3 \end{array} = 1 \text{ day}$$

$$5 \) \ 32 \quad 10 \) \ 72$$

6 furlongs 16 perches

7 hours 12 min.

Page 119.

$$5. \quad \begin{array}{r} 100 \text{ cents} = 1 \text{ dollar} \\ 4 \\ \hline \end{array}$$

$$5 \overline{) 400}$$

80 cents

Case 10.

$$3. \quad \begin{array}{r} 31 \text{ galls. 2 qts.} \\ 4 \\ \hline \end{array}$$

126 quarts

$$\begin{array}{r} 63 \text{ galls.} = 1 \text{ hhd.} \\ 4 \\ \hline \end{array}$$

252 quarts

Wherefore, $\frac{126}{252} = \frac{1}{2}$ is the fraction required

$$4. \quad \begin{array}{r} \text{cwt. gr. lb.} \\ 6 \ 2 \ 18\frac{2}{3} \\ 4 \\ \hline \end{array}$$

26

28

216

53

746

3

$$\begin{array}{r} \text{cwt.} \\ 20 = 1 \text{ ton} \\ 4 \\ \hline \end{array}$$

80

28

2240

3

6720 thirds of a pound

2240 thirds of a pound

Wherefore, $\frac{2240}{6720} = \frac{1}{3}$ is the fraction required

Case 11. Page 120.

$$2. \quad 20 \overline{) 17,00} (,85$$

ADDITION OF VULGAR FRACTIONS.

Case 1.

$$2. \quad \frac{4+8+13+16+19}{25} = \frac{60}{25} = 2\frac{2}{5}$$

$$3. \quad \frac{15+25+45+55}{60} = \frac{140}{60} = 2\frac{1}{3}$$

Case 2. Page 121.

<p>Given denominators</p> <p>2. $2 \overline{) 2 \ 4 \ 5 \ 8}$</p> <p>$2 \overline{) 1 \ 2 \ 5 \ 4}$</p> <p>$1 \ 1 \ 5 \ 2$</p>	<p>40 com. denominator</p> <hr/> <p>And 2 $\left \begin{array}{l} 20 \text{ first numerator} \\ 10 \text{ second} \text{ ' } \\ 8 \text{ third} \text{ ' } \\ 5 \text{ fourth} \text{ ' } \end{array} \right.$</p>
--	--

Then, $2 \times 2 \times 5 \times 2 = 40$ common denominator

Wherefore, $\frac{20+10+8+5}{40} = \frac{43}{40} = 1 \frac{3}{40}$

<p>Given denominators</p> <p>3. $5 \overline{) 5 \ 6 \ 7 \ 8 \ 15}$</p> <p>$3 \overline{) 1 \ 6 \ 7 \ 8 \ 3}$</p> <p>$2 \overline{) 1 \ 2 \ 7 \ 8 \ 1}$</p> <p>$1 \ 1 \ 7 \ 4 \ 1$</p>	<p>840 com. denominator</p> <hr/> <p>Then, 5 $\left \begin{array}{l} 168 \times 4 = 672 \\ 140 \times 5 = 700 \\ 120 \times 6 = 720 \\ 105 \times 3 = 315 \\ 56 \times 8 = 448 \end{array} \right.$</p>
--	---

Now, $5 \times 3 \times 2 \times 7 \times 4 = 840$ com. denom. 2855 sum

Wherefore, $\frac{2855}{840} = 3 \frac{67}{168}$

Case 3. Page 122.

3. $\frac{4}{5}$ of $\frac{1}{3} = \frac{4}{15}$

Then, $\frac{3}{5} + \frac{4}{15} + \frac{3}{20} = \frac{36+16+9}{60} = \frac{61}{60} = 1 \frac{1}{60}$

Wherefore, $1 + 9 + 1 \frac{1}{60} = 11 \frac{1}{60}$

4. $\frac{2}{3}$ of $\frac{1}{2} = \frac{1}{3}$

Then, $\frac{9}{10} + \frac{7}{8} + \frac{1}{3} + \frac{1}{2} = \frac{108+105+40+60}{120} = \frac{313}{120} = 2 \frac{73}{120}$

Lastly, $1 + 6 + 7 + 2 \frac{73}{120} = 16 \frac{73}{120}$

Case 4.

<p>2. $\frac{1}{2}$ of a yard $\overset{\text{ft. in.}}{=} 1 \ 6$</p> <p>$\frac{2}{3}$ of a foot $\overset{\text{ft. in.}}{=} 0 \ 8$</p> <hr/> <p>Sum 2 ft. 2 in.</p>	<p>3. $\frac{1}{3}$ of a day $\overset{\text{h. m.}}{=} 8 \ 0$</p> <p>$\frac{1}{2}$ of an hour $\overset{\text{h. m.}}{=} 0 \ 30$</p> <hr/> <p>Sum 8 h. 30 mi.</p>
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Page 122.

	<i>d. h. m.</i>	<i>yds. ft. in.</i>
4. $\frac{1}{3}$ of a week	= 2 8 0	5. $\frac{7}{8}$ of a mile = 1540 0 0
$\frac{1}{4}$ of a day	= 0 6 0	$\frac{2}{3}$ of a yard = 0 2 0
$\frac{1}{2}$ of an hour	= 0 0 30	$\frac{3}{4}$ of a foot = 0 0 9
<hr/> Sum 2 d. 14 hrs. 30 mi.		<hr/> 1540y. 2ft 9 in.

SUBTRACTION OF VULGAR FRACTIONS.

Page 123.

4. $\frac{11}{12} - \frac{3}{4} = \frac{11}{12} - \frac{9}{12} = \frac{11-9}{12} = \frac{2}{12} = \frac{1}{6}$
5. $\frac{5}{6} - \frac{4}{5} = \frac{25}{30} - \frac{24}{30} = \frac{25-24}{30} = \frac{1}{30}$
6. $\frac{209}{216} - \frac{7}{144} = \frac{418}{432} - \frac{21}{432} = \frac{418-21}{432} = \frac{397}{432}$
7. $\frac{15}{16} - \frac{11}{12} = \frac{45}{48} - \frac{44}{48} = \frac{45-44}{48} = \frac{1}{48}$
8. $12\frac{5}{12} - 6\frac{1}{2} = 12\frac{5}{12} - 6\frac{6}{12} = 5\frac{11}{12}$
9. $13\frac{1}{9} - 8\frac{14}{27} = 13\frac{3}{27} - 8\frac{14}{27} = 4\frac{16}{27}$
10. $10\frac{3}{10} - 1\frac{7}{12} = 10\frac{18}{60} - 1\frac{35}{60} = 8\frac{43}{60}$
11. $19\frac{5}{11} - \frac{7}{15} = 19\frac{75}{165} - \frac{77}{165} = 18\frac{163}{165}$
13. $\begin{array}{r} \text{w. d. h. mi.} \\ 7 \text{ weeks} = 7 \quad 0 \quad 0 \quad 0 \\ 9\frac{7}{10} \text{ days} = 1 \quad 2 \quad 16 \quad 48 \end{array}$

Diff. 5 w. 4 d. 7 h. 12 min.

MULTIPLICATION OF VULGAR FRACTIONS.

Page 124.

3. $\frac{3}{8} \times \frac{4}{5} = \frac{12}{40} = \frac{3}{10}$
4. $\frac{2}{5}$ of $\frac{3}{4} = \frac{6}{20} = \frac{3}{10}$ Then, $\frac{3}{10} \times \frac{1}{2} = \frac{3}{20}$
5. $7\frac{1}{2} \times \frac{1}{4} = \frac{15}{2} \times \frac{1}{4} = \frac{15}{8} = 1\frac{7}{8}$
6. $\frac{3}{4}$ of 9 = $\frac{27}{4}$ Then, $\frac{27}{4} \times \frac{7}{8} = \frac{189}{32} = 5\frac{29}{32}$

Page 124.

$$7. \quad 48\frac{3}{5} \times 13\frac{5}{6} = \frac{24}{5} \times \frac{83}{6} = \frac{672}{10} = 67\frac{2}{10}$$

DIVISION OF VULGAR FRACTIONS.

Page 125.

$$3. \quad \frac{3}{8} \div \frac{6}{7} = \frac{3}{8} \times \frac{7}{6} = \frac{21}{48} = \frac{7}{16}$$

$$4. \quad \frac{17}{21} \div \frac{3}{5} = \frac{17}{21} \times \frac{5}{3} = \frac{85}{63} = 1\frac{22}{63}$$

$$5. \quad 1\frac{1}{2} \div 4\frac{8}{10} = \frac{3}{2} \times \frac{5}{4} = \frac{15}{8} = \frac{5}{16}$$

$$6. \quad \frac{7}{8} \div 4 = \frac{7}{8} \times \frac{1}{4} = \frac{7}{32}$$

$$7. \quad 9\frac{1}{6} = \frac{55}{6}, \text{ \& } \frac{1}{2} \text{ of } 7 = \frac{7}{2} \quad \text{Now, } \frac{55}{6} \div \frac{7}{2} = \frac{55}{6} \times \frac{2}{7} = \frac{110}{42} = 2\frac{13}{21}$$

$$8. \quad 5205\frac{1}{5} = 2602\frac{2}{5}, \text{ and } \frac{4}{5} \text{ of } 91 = 36\frac{4}{5}$$

$$\text{Now, } 2602\frac{2}{5} \div 36\frac{4}{5} = 2602\frac{2}{5} \times \frac{5}{364} = 2602\frac{2}{5} \div 364 = 71\frac{1}{2}$$

RULE OF THREE IN VULGAR FRACTIONS.

$$2. \quad \text{As } \frac{2}{3} \text{ ton. : } 4\frac{9}{3} \text{ dolls. (=164}\frac{1}{3} \text{ dolls.) : } \frac{6}{7} \text{ ton.}$$

$$\text{Then, } \frac{\cancel{3}}{2} \times \frac{493}{\cancel{3}} \times \frac{\cancel{6}}{7} = \frac{1479}{7} = 211 \frac{284}{7}$$

$$3. \quad \frac{3}{4} \text{ of } \frac{3}{5} = \frac{9}{20}; \text{ Then, As } \frac{9}{20} : 171 :: 1 : \frac{171 \times 20}{9} = 380$$

$$4. \quad \text{As } 1 \text{ yd. dolls. : } \frac{5}{6} :: 42 \text{ yds. : } \frac{42 \times 5}{6} = 35$$

$$5. \quad \frac{2}{3} \text{ of } \frac{2}{5} = \frac{4}{15}; \text{ Then say,}$$

$$\text{As } \frac{4}{15} \text{ dolls. : } 312 :: 1 : \frac{312 \times 15}{4} = 1170$$

Page 126.

$$6. \quad 1\frac{1}{3} = \frac{4}{3}, 79\frac{1}{3} = 23\frac{8}{3}, \text{ and } 3\frac{2}{3} = \frac{17}{3}$$

$$\text{Now, as } \frac{4}{3} \text{ bu. : } 23\frac{8}{3} \text{ cts. :: } \frac{17}{3} \text{ bu. : } 202\frac{3}{10} \text{ cts.}$$

$$\text{Because, } \frac{\cancel{3}}{4} \times \frac{238}{\cancel{3}} \times \frac{17}{5} = \frac{4046}{20} = 202\frac{3}{10}$$

$$7. \quad \text{As } 17535 : \frac{1}{8} :: 60120 : \frac{3}{7}$$

$$\text{Because, } \frac{60120}{17535 \times 8} = \frac{60120}{140280} = \frac{3}{7}$$

INVERSE PROPORTION.

Page 126.

2. $6\frac{1}{2}\text{cwt.} = \frac{13}{2}\text{cwt.}$ and $22\frac{9}{6} = \frac{581}{6}$ miles

cwt. cwt. mi. miles

Now, as $1 : \frac{13}{2} :: \frac{581}{6} : 145\frac{1}{4}$

Because, $\frac{13}{2} \times \frac{581}{6} = \frac{581}{2 \times 2} = 145\frac{1}{4}$ miles

men men days days

3. As $16 : 12 :: \frac{18}{5}^3 (=37\frac{3}{5}) : 28\frac{1}{5}$ days

47 3

Because, $\frac{\cancel{18}^8 \times \cancel{12}}{5 \times \cancel{16}} = \frac{141}{5} = 28\frac{1}{5}$ days

4

4. $100\frac{2}{3}\text{dolls.} = \frac{302}{3}\text{dolls.}$ $6\frac{2}{3}\text{mo.} = \frac{20}{3}\text{months}$

$3\frac{5}{6}\text{years} = \frac{23}{6}\text{years} = 46\text{months}$

mo. mo. dolls.

Then, as $46 : \frac{20}{3} :: \frac{302}{3} : 14\frac{122}{67}$ dollars.

Because, $\frac{302 \times 20}{46 \times 3 \times 3} = \frac{6040}{414} = 14\frac{122}{67}$

ft. ft. ft. ft.

5. As $\frac{7}{8} : \frac{3}{4} :: \frac{41}{2} (=20\frac{1}{2}) : 17\frac{4}{7}$ feet.

Because, $\frac{\cancel{8}^8}{7} \times \frac{3}{\cancel{4}} \times \frac{41}{2} = \frac{3 \times 41}{7} = \frac{123}{7} = 17\frac{4}{7}$ feet

6. $20\frac{1}{2}\text{yards} = \frac{41}{2}\text{yards}$ $1\frac{1}{4}\text{yard} = \frac{5}{4}\text{yards}$

Now, as $\frac{3}{4}\text{yd.} : \frac{5}{4}\text{yd.} :: \frac{41}{2}\text{yd.} : 34\frac{1}{6}\text{yards}$

Because, $\frac{\cancel{4}}{3} \times \frac{5}{\cancel{4}} \times \frac{41}{2} = \frac{205}{6} = 34\frac{1}{6}$ yards

INVOLUTION, OR RAISING OF POWERS.

Page 128.

2. $(35)^4 = 35 \times 35 \times 35 \times 35 = 1500625$

3. $(1,03)^3 = 1,03 \times 1,03 \times 1,03 = 1,092727$

Page 128.

$$4. \quad (,029)^5 = ,029 \times ,029 \times ,029 \times ,029 \times ,029 \\ = ,000000020511149^*$$

$$5. \quad \left(\frac{3}{4}\right)^4 = \frac{3}{4} \times \frac{3}{4} \times \frac{3}{4} \times \frac{3}{4} = \frac{81}{256}$$

SQUARE ROOT.

Page 129.

$$2. \quad \begin{array}{r} 106929(327 \text{ root required} \\ 9 \\ \hline \end{array}$$

$$\begin{array}{r} 62)169 \\ 124 \\ \hline \end{array}$$

$$\begin{array}{r} 647)4529 \\ 4529 \\ \hline \end{array}$$

$$3. \quad \begin{array}{r} 4782969(2187 \text{ root required} \\ 4 \\ \hline \end{array}$$

$$\begin{array}{r} 41)78 \\ 41 \\ \hline \end{array}$$

$$\begin{array}{r} 428)3729 \\ 3424 \\ \hline \end{array}$$

$$\begin{array}{r} 4367)30569 \\ 30569 \\ \hline \end{array}$$

$$4. \quad \begin{array}{r} 43046721(6561 \text{ root required} \\ 36 \\ \hline \end{array}$$

$$\begin{array}{r} 125)704 \\ 625 \\ \hline \end{array}$$

$$\begin{array}{r} 1306)7967 \\ 7836 \\ \hline \end{array}$$

$$\begin{array}{r} 13121)13121 \\ 13121 \\ \hline \end{array}$$

$$5. \quad \begin{array}{r} 387420489(19683 \text{ root req.} \\ 1 \\ \hline \end{array}$$

$$\begin{array}{r} 29)287 \\ 261 \\ \hline \end{array}$$

$$\begin{array}{r} 386)2642 \\ 2316 \\ \hline \end{array}$$

$$\begin{array}{r} 3928)32604 \\ 31424 \\ \hline \end{array}$$

$$\begin{array}{r} 39363)118089 \\ 118089 \\ \hline \end{array}$$

$$6. \quad \begin{array}{r} 22071204(4698 \text{ root req.} \\ 16 \\ \hline \end{array}$$

$$\begin{array}{r} 86)607 \\ 516 \\ \hline \end{array}$$

$$\begin{array}{r} 929)9112 \\ 8361 \\ \hline \end{array}$$

$$\begin{array}{r} 9388)75104 \\ 75104 \\ \hline \end{array}$$

$$7. \quad \begin{array}{r} 36372961(6031 \text{ root req.} \\ 36 \\ \hline \end{array}$$

$$\begin{array}{r} 1203)03729 \\ 3609 \\ \hline \end{array}$$

$$\begin{array}{r} 12061)12061 \\ 12061 \\ \hline \end{array}$$

* The answer given with the question is the 4th power of ,029.

Page 129.

$$8. \quad \begin{array}{r} \dot{2}2\dot{6}8\dot{7}4\dot{1} \\ 1 \\ \hline \end{array} (1506,23 + \text{root req.} \quad 9. \quad \begin{array}{r} \dot{7}5\dot{9}6\dot{7}9\dot{6} \\ 4 \\ \hline \end{array} (2756,228 + \text{root req.}$$

$$25) \begin{array}{r} 126 \\ 125 \\ \hline \end{array}$$

$$47) \begin{array}{r} 359 \\ 329 \\ \hline \end{array}$$

$$3006) \begin{array}{r} 18741 \\ 18036 \\ \hline \end{array}$$

$$545) \begin{array}{r} 3067 \\ 2725 \\ \hline \end{array}$$

$$30122) \begin{array}{r} 70500 \\ 60244 \\ \hline \end{array}$$

$$5506) \begin{array}{r} 34296 \\ 33036 \\ \hline \end{array}$$

$$301243) \begin{array}{r} 1025600 \\ 903729 \\ \hline \end{array}$$

$$55122) \begin{array}{r} 126000 \\ 110244 \\ \hline \end{array}$$

121871 remainder.

$$551242) \begin{array}{r} 1575600 \\ 1102484 \\ \hline \end{array}$$

$$5512448) \begin{array}{r} 47311600 \\ 44099584 \\ \hline \end{array}$$

Page 130.

3212016 remainder

$$10. \quad \begin{array}{r} \dot{9}7\dot{1}2,7\dot{1}8\dot{0}5\dot{1} \\ 81 \\ \hline \end{array} (98,553 + \text{root req.} \quad 11. \quad \begin{array}{r} \dot{3},1\dot{7}2\dot{1}8\dot{1}2\dot{0} \\ 1 \\ \hline \end{array} (1,78106 + \text{root req.}$$

$$188) \begin{array}{r} 1612 \\ 1504 \\ \hline \end{array}$$

$$27) \begin{array}{r} 217 \\ 189 \\ \hline \end{array}$$

$$1965) \begin{array}{r} 10871 \\ 9825 \\ \hline \end{array}$$

$$348) \begin{array}{r} 2821 \\ 2784 \\ \hline \end{array}$$

$$19705) \begin{array}{r} 104680 \\ 98525 \\ \hline \end{array}$$

$$3561) \begin{array}{r} 3781 \\ 3561 \\ \hline \end{array}$$

$$197103) \begin{array}{r} 615551 \\ 591309 \\ \hline \end{array}$$

$$356206) \begin{array}{r} 2202000 \\ 2137236 \\ \hline \end{array}$$

24242 remainder

64764 remainder

$$12. \quad \begin{array}{r} \dot{4}7\dot{9}5,2\dot{5}7\dot{3}1\dot{0} \\ 36 \\ \hline \end{array} (69,247 + \text{root req.} \quad 13. \quad \begin{array}{r} \dot{0},000\dot{0}8\dot{8}3\dot{6} \\ 81 \\ \hline \end{array} (,0094 \text{ root req.}$$

$$129) \begin{array}{r} 1195 \\ 1161 \\ \hline \end{array}$$

$$184) \begin{array}{r} 736 \\ 736 \\ \hline \end{array}$$

$$1382) \begin{array}{r} 3425 \\ 2764 \\ \hline \end{array}$$

$$13844) \begin{array}{r} 66173 \\ 55376 \\ \hline \end{array}$$

$$138487) \begin{array}{r} 1079710 \\ 969409 \\ \hline \end{array}$$

110301

Square root of vulgar fractions.

Page 130.

1. The greatest common divisor is 576

$$576) \frac{2304}{5184} = \frac{4}{9}; \text{ Then, } \sqrt{\frac{4}{9}} = \frac{2}{3}$$

2. The greatest common measure is 169

$$169) \frac{2704}{4225} = \frac{16}{25}; \text{ Now, } \sqrt{\frac{16}{25}} = \frac{4}{5}$$

- 3.
- $\frac{15625}{1}$
- (125 num.
- $\frac{46656}{4}$
- (216 denom.

$$\begin{array}{r} 22)056 \\ 44 \\ \hline \end{array}$$

$$\begin{array}{r} 41)066 \\ 41 \\ \hline \end{array}$$

$$\begin{array}{r} 245)1225 \\ 1225 \\ \hline \end{array}$$

$$\begin{array}{r} 426)2556 \\ 2556 \\ \hline \end{array}$$

That is $\sqrt{\frac{15625}{46656}} = \frac{125}{216}$, root required*Surds.*

- 4.
- $\frac{357}{476} = .75$
- ; Then,
- $\sqrt{.75} = .86602$

- 5.
- $\frac{478}{549} = .8706739526$
- Then,
- $\sqrt{.8706739526} = .93309$

- 6.
- $\frac{387}{738} = .5243902439$
- Then,
- $\sqrt{.5243902439} = .72414$

Square root of mixed numbers.

Page 131.

- 1.
- $37\frac{36}{49} = 37\frac{1849}{49}$
- Then,
- $\sqrt{37\frac{1849}{49}} = 4\frac{3}{7} = 6\frac{1}{7}$

- 2.
- $27\frac{9}{16} = 27\frac{441}{16}$
- Then,
- $\sqrt{27\frac{441}{16}} = 5\frac{1}{4}$

- 3.
- $51\frac{21}{25} = 51\frac{1296}{25}$
- Then,
- $\sqrt{51\frac{1296}{25}} = 7\frac{1}{5}$

- 4.
- $94\frac{3}{9} = 94\frac{484}{9}$
- Then,
- $\sqrt{94\frac{484}{9}} = 2\frac{2}{7} = 3\frac{1}{7}$

Surds.

- 5.
- $\sqrt{7\frac{9}{11}} = \sqrt{7.818181 \text{ \&c.}} = 2.7961 +$

- 6.
- $\sqrt{8\frac{5}{7}} = \sqrt{8.71428571 \text{ \&c.}} = 2.9519 +$

- 7.
- $\sqrt{85\frac{14}{15}} = \sqrt{85.9333 \text{ \&c.}} = 9.27 +$

Any two sides of a right angled triangle given to find the third side.

Page 132.

$$\begin{array}{r} 1. \quad 36 \times 36 = 1296 \\ 27 \times 27 = 729 \\ \hline \end{array}$$

Sum 2025

Now, $\sqrt{2025} = 45$ feet

$$\begin{array}{r} 2. \quad 45 \times 45 = 2025 \\ 60 \times 60 = 3600 \\ \hline \end{array}$$

Sum 5625

Then, $\sqrt{5625} = 75$ yards

$$\begin{array}{r} 3. \quad 45 \times 45 = 2025 \text{ AC squared} \\ 27 \times 27 = 729 \text{ AB squared} \\ \hline \end{array}$$

Diff. 1296 BC squared

Then, $\sqrt{1296} = 36$ feet

$$\begin{array}{r} 4. \quad 75 \times 75 = 5625 \\ 45 \times 45 = 2025 \\ \hline \end{array}$$

Diff. 3600

Then, $\sqrt{3600} = 60$ feet

To find the side of a square equal in area to any given superficies.

Page 133.

$$1. \quad \sqrt{160} = 12,6491106$$

$$2. \quad \sqrt{2025} = 45$$

$$3. \quad \sqrt{750} = 27,3861279$$

To find the diameter of a circle of a given proportion, larger or less than a given one.

$$1. \quad 4 \times 4 = 16, \text{ and } 16 \times 4 = 64 \quad \text{Then, } \sqrt{64} = 8 \text{ feet.}$$

$$2. \quad 100^2 \times 3 = 30000 \quad \text{Then, } \sqrt{30000} = 173,20508 \text{ feet.}$$

$$3. \quad \frac{12 \times 12}{2} = 72 \quad \text{Then, } \sqrt{72} = 8,4852814 \text{ inches}$$

The area of a circle given to find the diameter.

RULE. Divide the given area by ,7854 and the quotient is the square of the diameter.

Page 133.

$$1. \quad \sqrt{160 \div 7854} = \sqrt{203,717850776674} = 14,272976$$

Or, by the rule in the "Calculator."

$$\sqrt{160} = 12,6491106$$

$$1,12837$$

$$885437742$$

$$379473318$$

$$1011928848$$

$$252982212$$

$$1391402166$$

$$14,272876927722 \text{ diameter}$$

2. Because 160 perches is an acre, the diameter is the same as in the foregoing example. Consequently the half diameter, or length of the halter, will be

$$14,272976 \div 2 = 7,136488 \text{ perches}$$

$$16\frac{1}{2} \text{ feet}$$

$$114183808$$

$$3568244$$

$$\text{feet } 117,752052$$

$$12$$

$$\text{inches } 9,024624$$

117 feet 9 inches the length of the halter

Application.

Page 134.

$$\text{Quest. 1. } \sqrt{20736} = 144 \text{ men} \quad 2. \quad 25 \times 25 = 625 \text{ feet}$$

$$3. \quad \sqrt{197136} = 444 \text{ stones}$$

4. $600 \div \frac{40}{2} = \frac{600}{20} = 30$ the perpendicular. Because the perpendicular and the other side is the same, viz:—30 perches, the triangle is right angled. Consequently,

$$\sqrt{40^2 + 30^2} = \sqrt{1600 + 900} = \sqrt{2500} = 50 \text{ perches}$$

Page 134.

5. $84 \times 84 = 7056$

$50 \times 50 = 2500$

$\underline{\hspace{1cm}}$
9556

Then, $\sqrt[3]{9556} = 97,7547 + \text{miles}$

6. $\overset{\text{root required}}{964,5192360241(31,05671}$
 $\underline{\hspace{1cm}}$

61) 64
61
 $\underline{\hspace{1cm}}$

6205) 35192
31025
 $\underline{\hspace{1cm}}$

62106) 416736
372636
 $\underline{\hspace{1cm}}$

621127) 4410002
4347889
 $\underline{\hspace{1cm}}$

6211341) 6211341
6211341
 $\underline{\hspace{1cm}}$

7. $\overset{\text{root required}}{1030892198,4001(32107,51}$
 $\underline{\hspace{1cm}}$

62) 130
124
 $\underline{\hspace{1cm}}$

641) 689
641
 $\underline{\hspace{1cm}}$

64207) 482198
449449
 $\underline{\hspace{1cm}}$

642145) 3274940
3210725
 $\underline{\hspace{1cm}}$

6421501) 6421501
6421501
 $\underline{\hspace{1cm}}$

CUBE ROOT.

Page 138.

2. $2 \times 2 \times 3 = 12..$

square of 4 = 16

$2 \times 4 \times 30 = 240$
 $\underline{\hspace{1cm}}$

complete divisor $1456 \times 4 =$

$\overset{\text{root required}}{13824(24}$

8

$\underline{\hspace{1cm}}$
5824

5824

3. $7 \times 7 \times 3 = 147..$

square of 2 = 04

$7 \times 2 \times 30 = 420$
 $\underline{\hspace{1cm}}$

complete divisor $15124 \times 2 = 30248$

$\overset{\text{root required}}{373248(72}$

343

$\underline{\hspace{1cm}}$
30248

4. $1 \times 1 \times 3 = 3..$

square of 7 = 49

$1 \times 7 \times 30 = 210$
 $\underline{\hspace{1cm}}$

complete divisor $559 \times 7 = 3913$

$17 \times 17 \times 3 = 867..$

square of 9 = 81

$17 \times 9 \times 30 = 4590$
 $\underline{\hspace{1cm}}$

complete divis. $91371 \times 9 = 822339$

$\overset{\text{root required}}{5735339(179}$

1

$\underline{\hspace{1cm}}$
4735

$\underline{\hspace{1cm}}$
822339

Page 138.

$$\begin{array}{rcl}
 5. & 4 \times 4 \times 3 = 48 \dots & 84604519 (439 \text{ root required}) \\
 & \text{square of } 3 = 09 & 64 \\
 & 4 \times 3 \times 30 = 360 & \text{—} \\
 & & 20604
 \end{array}$$

$$\text{complete divisor } 5169 \times 3 = 15507$$

$$\begin{array}{rcl}
 & 43 \times 43 \times 3 = 5547 \dots & 5097519 \\
 & \text{square of } 9 = 81 & \\
 & 43 \times 9 \times 30 = 11610 & \text{—}
 \end{array}$$

$$\text{comp. divisor } 566391 \times 9 = 5097519$$

$$\begin{array}{rcl}
 6. & 3 \times 3 \times 3 = 27 \dots & 27054036008 (3002 \text{ root}) \\
 & \text{defective divisor } 2700 \dots & 27 \\
 & \text{defective divisor } 270000 \dots & \text{—} \\
 & \text{square of } 2 = 04 & 054036008 \\
 & 300 \times 2 \times 30 = 18000 & \text{—}
 \end{array}$$

$$\text{complete divisor } 27018004 \times 2 = 54036008$$

$$\begin{array}{rcl}
 7. & 4 \times 4 \times 3 = 48 \dots & 122615327232 (4968 \text{ root}) \\
 & \text{square of } 9 = 81 & 64 \\
 & 4 \times 9 \times 30 = 1080 & \text{—} \\
 & & 58615 \\
 & \text{complete divisor } 5961 \times 9 = & 53649 \\
 & & 1080 \\
 & 9^2 \times 2 = 162 & 4966327 \text{ dividend}
 \end{array}$$

$$\begin{array}{rcl}
 & \text{defective divisor}^* 7203 \dots & \\
 & \text{square of } 6 = 36 & \\
 & 49 \times 6 \times 30 = 8820 & \text{—}
 \end{array}$$

$$\text{complete divisor } 729156 \times 6 = 4374936 \text{ subtrahend}$$

$$\begin{array}{rcl}
 & 8820 & \text{—} \\
 & 6^2 \times 2 = 72 & 591391232 \text{ dividend}
 \end{array}$$

$$\begin{array}{rcl}
 & \text{defective divisor } 738048 \dots & \\
 & \text{square of } 8 = 64 & \\
 & 496 \times 8 \times 30 = 119040 & \text{—}
 \end{array}$$

$$\text{complete divisor } 73923904 \times 8 = 591391232 \text{ subtrahend}$$

* *Defective divisors*, after the first, may be more concisely found by addition, thus: To the last complete divisor, add the number which completed it, with twice the square of the last figure in the root; the sum will be the next defective divisor.

$$\begin{array}{rcl}
 8. & 2 \times 2 \times 3 = 12 \dots & 22069810125(2805 \text{ root} \\
 & \text{square of } 8 = 64 & 8 \\
 & 2 \times 8 \times 30 = 480 & \text{---}
 \end{array}$$

$$\begin{array}{rcl}
 & & 14069 \\
 \text{complete divisor } 1744 \times 8 = & & 13952 \\
 & 480 & \text{---}
 \end{array}$$

$$8^2 \times 2 = 128 \quad 117810125 \text{ dividend}$$

$$\text{defective divisor } 235200 \dots$$

$$\text{square of } 5 = 25$$

$$280 \times 5 \times 30 = 42000$$

$$\text{complete divisor } 23562025 \times 5 = 117810125 \text{ subtrahend}$$

$$\begin{array}{rcl}
 9. & 6 \times 6 \times 3 = 108 \dots & 219365327791(6031 \\
 \text{defective divisor } 10800 \dots & & 216
 \end{array}$$

$$\text{square of } 3 = 09 \quad 3365327$$

$$60 \times 3 \times 30 = 5400$$

$$\begin{array}{rcl}
 \text{complete divisor } 1085409 \times 3 = & & 3256227 \\
 & 5400 & \text{---}
 \end{array}$$

$$\text{square of } 3 \times 2 = 18 \quad 109100791$$

$$\text{defective divisor } 1090827 \dots$$

$$\text{square of } 1 = 01$$

$$603 \times 1 \times 30 = 18090$$

$$109100791 \times 1 = 109100791$$

$$10. \quad 8 \times 8 \times 3 = 192 \dots \quad 673373097125(8765 \text{ root required}$$

$$\text{square of } 7 = 49 \quad 512$$

$$8 \times 7 \times 30 = 1680 \quad 161373$$

$$\text{complete divisor } 20929 \times 7 = 146503$$

$$1680 \quad 14870097$$

$$\text{twice the sq. of } 7 = 98$$

$$\text{defective divisor } 22707 \dots$$

$$\text{square of } 6 = 36$$

$$87 \times 6 \times 30 = 15660$$

$$\text{complete divisor } 2286396 \times 6 = 13718376$$

$$15660 \quad 1151721125$$

$$\text{twice the sq. of } 6 = 72$$

$$\text{defective divisor } 2302128 \dots$$

$$\text{square of } 5 = 25$$

$$876 \times 5 \times 30 = 131400$$

$$\text{complete divisor } 230344225 \times 5 = 1151721125$$

Page 138.

11.	$2 \times 2 \times 3 = 12 \dots$	$12,977875(2,35 \text{ root}$
	square of 3 = 09	8
	$2 \times 3 \times 30 = 180$	<u>4977</u>
	complete divisor $1389 \times 3 =$	4167
	180	<u> </u>
twice the sq. of 3 =	18	810875
	defective divisor 1587 ..	
	square of 5 = 25	
	$23 \times 5 \times 30 = 3450$	
	complete divisor $162175 \times 5 =$	810875
12.	$2 \times 2 \times 3 = 12 \dots$	$15926,972504(25,16 +$
	square of 5 = 25	8
	$2 \times 5 \times 30 = 300$	<u> </u>
	complete divisor $1525 \times 5 =$	7926
	300	<u>7625</u>
twice the sq. of 5 =	50	301972
	defective divisor 1875 ..	
	square of 1 = 01	
	$25 \times 1 \times 30 = 750$	
	complete divisor $188251 \times 1 =$	188251
	750	<u> </u>
twice the sq. of 1 =	2	113721504
	defective divisor 189003 ..	
	square of 6 = 36	
	$251 \times 6 \times 300 = 45180$	
	complete divisor $18945516 \times 6 =$	113673096
		<u> </u>
		48408 rem.
13.	$3 \times 3 \times 3 = 27 \dots$	$36155,027576(33,06$
	square of 3 = 09	27
	$3 \times 3 \times 30 = 270$	<u>9155</u>
	complete divisor $2979 \times 3 =$	8937
	$33 \times 33 \times 3 = 3267 \dots$	<u>218027576</u>
	defective divisor 326700 ..	
	square of 6 = 36	
	$330 \times 6 \times 30 = 59400$	
	complete divisor $32729436 \times 6 =$	196376616
		<u> </u>
		21650960 rem.

Page 139.

$$\begin{array}{rcl}
 14. & 3 \times 3 \times 3 = 27 \dots & ,053258279(,376 + \text{root} \\
 & \text{square of } 7 = 49 & 27 \\
 & 3 \times 7 \times 30 = 630 & \text{---} \\
 & & 26258 \\
 \text{complete divisor } 3379 \times 7 = & 23653 & \text{---} \\
 & & 2605279 \\
 & 37 \times 37 \times 3 = 4107 \dots & \\
 & \text{square of } 6 = 36 & \\
 & 37 \times 3 \times 30 = 3330 & \\
 & \text{---} & \\
 \text{complete divisor } 414066 \times 6 = & 2484396 & \\
 & & \text{---} \\
 & & 120883 \text{ remainder}
 \end{array}$$

$$\begin{array}{rcl}
 15. & 1 \times 1 \times 3 = 3 \dots & ,001906624(,124 \text{ root} \\
 & \text{square of } 2 = 04 & 1 \\
 & 1 \times 2 \times 30 = 60 & \text{---} \\
 & & 906 \\
 \text{complete divisor } 364 \times 2 = & 728 & \text{---} \\
 & & 178624 \\
 & 12 \times 12 \times 3 = 432 \dots & \\
 & \text{square of } 4 = 16 & \\
 & 12 \times 4 \times 30 = 1440 & \\
 & \text{---} & \\
 \text{complete divisor } 44656 \times 4 = & 178624 &
 \end{array}$$

$$\begin{array}{rcl}
 16. & ,000000729(,009 \text{ root required} & \\
 & 729 &
 \end{array}$$

$$\begin{array}{rcl}
 17. & 1 \times 1 \times 3 = 3 \dots & 2,(1,25 + \text{root} \\
 & \text{square of } 2 = 04 & 1 \\
 & 1 \times 2 \times 30 = 60 & \text{---} \\
 & & 1000 \\
 \text{complete divisor } 364 \times 2 = & 728 & \text{---} \\
 & 12 \times 12 \times 3 = 432 \dots & 272000 \\
 & \text{square of } 5 = 25 & \\
 & 12 \times 5 \times 30 = 1800 & \\
 & \text{---} & \\
 \text{complete divisor } 45025 \times 5 = & 225125 & \text{---} \\
 & & 46875 \text{ remainder}
 \end{array}$$

Page 139.

To extract the cube root of a vulgar fraction.

1. $\frac{250}{686} = \frac{125}{343}$ Then, $\sqrt[3]{\frac{125}{343}} = \frac{5}{7}$ root required
2. $\frac{324}{1500} = \frac{27}{125}$ Then, $\sqrt[3]{\frac{27}{125}} = \frac{3}{5}$ root required
3. $\frac{1520}{5130} = \frac{8}{27}$ Then, $\sqrt[3]{\frac{8}{27}} = \frac{2}{3}$ root required

Surds.

4. $\sqrt[3]{4} = \sqrt[3]{,571428571 \text{ \&c.}} = ,829 + \text{root required}$
5. $\sqrt[3]{2} = \sqrt[3]{,666 \text{ \&c.}} = ,873 + \text{root required}$
6. $\sqrt[3]{5} = \sqrt[3]{,555 \text{ \&c.}} = ,822 + \text{root required}$

To extract the cube root of a mixed number.

1. $\sqrt[3]{31\frac{15}{343}} = \sqrt[3]{1\frac{0648}{343}} = \frac{22}{7} = 3\frac{1}{7}$
2. $\sqrt[3]{12\frac{19}{27}} = \sqrt[3]{3\frac{43}{27}} = \frac{7}{3} = 2\frac{1}{3}$
3. $\sqrt[3]{405\frac{28}{125}} = \sqrt[3]{5\frac{0653}{125}} = \frac{37}{5} = 7\frac{2}{5}$

Surds.

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4. $\sqrt[3]{7\frac{1}{5}} = \sqrt[3]{7,2} = 1,93 + \text{root required}$
5. $\sqrt[3]{8\frac{5}{7}} = \sqrt[3]{8,7142857 \text{ \&c.}} = 2,057 + \text{root required}$
6. $\sqrt[3]{9\frac{1}{6}} = \sqrt[3]{9,166 \text{ \&c.}} = 2,092 + \text{root required}$

To find the side of a cube that shall be equal to any given solid, as a globe, a cone, &c.

1. $\sqrt[3]{10648} = 22$
2. $\sqrt[3]{383017} = 73$

Note.

1. $2^3 \times 3 = 2 \times 2 \times 2 \times 3 = 24$

Then, $\sqrt[3]{24} = 2,8845 \text{ feet} = 2 \text{ feet } 10,614 \text{ inches}$

2. $12^3 \times 3 = 12 \times 12 \times 12 \times 3 = 5184$

Then, $\sqrt[3]{5184} = 17,306 \text{ inches}$

9*

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Application.

Quest. 1. As $6^3 : 3^3 \therefore 216 : 27 :: 32 \text{ lb.} : 4 \text{ lb.}$

2. $288 \times 216 \times 48 = 2985984$ Then, $\sqrt[3]{2985984} = 144$

3. $\sqrt[3]{389017} = 73$ Then, $73 \times 73 = 5329$

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Quest. 4. Because there is two half feet in a foot.

$$\frac{2 \times 2 \times 2}{2} = \frac{8}{2} = 4 \text{ solid half feet in half a solid foot}$$

And then, $4 - 1 = 3$ solid half feet

5. $2 \times 2 \times 2 = 8$ six inch cubes. And because there are three times 4 inches in a foot we find that there is $3 \times 3 \times 3 = 27$ four inch cubes in a solid foot.

ARITHMETICAL PROGRESSION.

Case 1. Page 142.

2. $(\overline{20-1} \times 3) + 3 = (19 \times 3) + 3 = 60$ last term

Then, $(60 + 3) \times \frac{20}{2} = 63 \times 10 = 630$ dollars 30 cents

3. Here 4 is the common difference

And $(\overline{100-1} \times 4) + 4 = (99 \times 4) + 4 = 400$ last term

Then, $(400 + 4) \times \frac{100}{2} = 404 \times 50 = 20200$ yards

But, $20200 \text{ yards} = 11 \text{ miles } 3 \text{ furlongs } 180 \text{ yards}$

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4. $(\overline{10-1} \times 10) + 20 = 90 + 20 = 110$ dollars last term

Then, $(110 + 20) \times \frac{10}{2} = 130 \times 5 = 650$ dollars the whole amount. And $650 \div 10 = 65$ dollars per annum

5. $(\overline{1000-1} \times 10) + 10 = 9990 + 10 = 10000$ cents, or 100 dollars for the last acre

And $(10000 + 10) \times \frac{1000}{2} = 500050$ dollars, whole cost

Case 2. Page 143.

$$2. \quad \frac{60-20}{21-1} = \frac{40}{20} = 2 \text{ the common difference}$$

Then, 20, 22, 24, 26, 28, &c. are their ages respectively

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$$3. \quad \frac{58-3}{12-1} = \frac{55}{11} = 5 \text{ miles daily increase}$$

And $(58+3) \times \frac{1}{2} = 61 \times 6 = 366$ miles whole distance

GEOMETRICAL PROGRESSION.

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$$2. \quad \begin{array}{l} \text{Indices} \quad 1 \quad 2 \quad 3 \quad 4 \\ \text{Ratio} \quad 2, \quad 4, \quad 8, \quad 16, \text{ powers of the ratio} \\ \quad \quad \quad 16 \end{array}$$

In this question the number of terms is 12

$$\overline{256} = 8^{\text{th}} \text{ power}$$

$$8 = 3^{\text{d}} \text{ power}$$

$$\overline{2048} = 11^{\text{th}} \text{ power of the ratio}$$

$$\times 1 \text{ the first term}$$

$$\overline{2048} = 12^{\text{th}} \text{ or last term of the } [\text{progression}]$$

$$\times 2 \text{ the ratio}$$

$$\overline{4096}$$

$$\text{Subtract} \quad 1 \text{ the first term}$$

$$\text{Ratio } 2-1=1) \overline{4095}$$

\$4095 the sum of the series

$$3. \quad \begin{array}{l} \text{Indices} \quad 1 \quad 2 \quad 3 \quad 4 \quad 5 \\ \text{Ratio} \quad 2, \quad 4, \quad 8, \quad 16, \quad 32, \text{ powers of the ratio} \\ \quad \quad \quad 32 \end{array}$$

$$\overline{64}$$

$$\overline{96}$$

Here the number of terms is 15

$$\overline{1024} = 10^{\text{th}} \text{ power}$$

$$\overline{16} = 4^{\text{th}} \text{ power}$$

$$\overline{16384} = 14^{\text{th}} \text{ power of the ratio.}$$

And because the first term of the progression is 1, the 14th power of the ratio is the last, or 15th term of the progression

$$\text{Then, } \frac{(16384 \times 2 \text{ ratio}) - 1}{\text{ratio } 2-1} = 32767 \text{ shillings} = 1638 \text{ £. } 7 \text{ s.}$$

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4. Indices 1 2 3 4
 Ratio 4, 16, 64, 256 powers of the ratio
 256

Here the number of terms is 12

$$\begin{array}{r} 1536 \\ 1280 \\ 512 \\ \hline 65536 = 8\text{th power} \\ 64 = 3\text{d power} \end{array}$$

$$\begin{array}{r} 262144 \\ 393216 \\ \hline \end{array}$$

4194304 = 11th power of the ratio, which is also the 12th or last term of the progression.

Then, $\frac{(4194304 \times 4) - 1}{4 - 1} = 55924 \text{ } ^{\text{dolls.}} \text{ } ^{\text{cts.}} 05$ sold for

And $12 \times 20 = 240 \text{ } 00$ cost

$\$55684 \text{ } 05$ gain

5. Indices 1 2 3 4 5 6 7
 Ratio 2, 4, 8, 16, 32, 64, 128, powers of the ratio
 128

Here the number of terms is 32

$$\begin{array}{r} 1024 \\ 256 \\ 128 \\ \hline \end{array}$$

$$\begin{array}{r} 16384 = 14\text{th power} \\ 16384 = \text{do.} \end{array}$$

$$\begin{array}{r} 65536 \\ 131072 \\ 49152 \\ 98304 \\ 16384 \\ \hline \end{array}$$

$$\begin{array}{r} 268435456 = 28\text{th power} \\ 8 = 3\text{d power} \end{array}$$

2147483648 = 31st. power of the ratio: And because the first term of the progression is 1, it is also the 32d or last term of the progression

Then, $\frac{(2147483648 \times 2) - 1}{2 - 1 \text{ Ratio}} = 4294967 \text{ d. } 29 \text{ cts. } 5 \text{ ms.}$

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6. Indices 1 2 3 4 5
Ratio 3, 9, 27, 81, 243 powers of the ratio

243

729

972

486

59049=10th power

59049= do

531441

236196

5314410

295245

3486784401=20th power

59049=10th power

31381059609

13947137604

313810596090

17433922005

205891132094649=30th power

3=single power

617673396283947=31st power of the ratio, or 32d

term of the progression

Then, $\frac{(617673396283947 \times 3) - 1}{\text{Ratio } 3-1} = 926510094425 \text{ d. } 92 \text{ c.}$

$$7. \quad 1 \times \frac{(4^{32} - 1)}{4 - 1} = \frac{18446744073709551615}{3} =$$

6148914691236517 dollars 20 cents 5 mills

$$8. \quad 2 \times \frac{(3^{30} - 1)}{3 - 1} = \frac{2 \times 205891132094648}{2} =$$

205891132094648 pins. Which at 1000 for a farthing amounts to

£.214469929 5 3½

cost of 30 yards at £100= 3000 0 0

gain £.214466929 5 3½

SINGLE POSITION.

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3. Suppose A paid 12 dollars

Then B 4 ‘

And C 1 ‘

 17 sum

Now, as $17 : 340 ::$ *dolls.* $\left\{ \begin{array}{l} 12 : 240 \text{ A paid} \\ 4 : 80 \text{ B } ' \\ 1 : 20 \text{ C } ' \end{array} \right.$

4. Suppose 60

 $\frac{1}{4} = 15$

$\frac{1}{5} = 12$

$\frac{1}{6} = 10$

 37

Now, as $37 : 60 :: 148 : \frac{148 \times 60}{37} = 240d.$

5. Suppose 12

 $\frac{1}{2} = 6$

$\frac{1}{3} = 4$

 10

 left 2

Then, as $2 : 12 :: 26\frac{2}{3} \text{ dolls.} : 160 \text{ dolls.}$

6. Suppose A's age 6

Then B's $= 6 \times 1\frac{1}{2} = 9$ And C's $= (6 + 9) \times 2\frac{1}{10} = 31\frac{1}{2}$

 46 $\frac{1}{2}$

Then, as $46,5 : 93 ::$ $\left\{ \begin{array}{l} 6 : 12 \text{ A's age} \\ 9 : 18 \text{ B's } ' \\ 31,5 : 63 \text{ C's } ' \end{array} \right.$

7. Suppose 1 to be the number

Then, $\frac{7}{8} - \frac{4}{5} = \frac{35-32}{40} = \frac{3}{40}$ difference

Now, as $\frac{3}{40} : 1 :: 6 : \frac{6 \times 40}{3} = 80$

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8. Suppose 1 the harness
 then 2 ' horse
 and 6 ' chaise

—
 9

dolls.

$$\text{Then, as } 9 : 360 :: \begin{cases} 1 : 40 \text{ dollars harness} \\ 2 : 80 \text{ dollars horse} \\ 6 : 240 \text{ dollars chaise} \end{cases}$$

9. Suppose 60

—
 $\frac{1}{3} = 20$

$\frac{1}{4} = 15$

$\frac{1}{5} = 12$

$\frac{1}{6} = 10$

—
 57

10. Suppose 12

$\frac{1}{3} = 4$

—
 A spends 8

2

—
 B spends 16

12

—
 B sinks 4

Now, *dolls. dolls.*
 as 57 : 60 :: 228 : 240

dolls. dolls.
 Then, as 4 : 12 :: 50 : 150

DOUBLE POSITION.

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2. Suppose 8

$\frac{1}{8} = 1$

—
 A spends 7

30

—
 B spends 37 per year

8

—
 B spends 296 in 8 years

$8 \times 8 = 64$

—
 B is indebted 232

40

—
 192 error too little

192 error $\times 40 = 7680$

160 error $\times 8 = 1280$

- Again, suppose 40

$\frac{1}{8} = 5$

—
 A spends 35 per year

30

—
 B spends 65 per year

8

—
 B spends 520 in 8 yrs.

$40 \times 8 = 320$

—
 B is indebted 200

40

—
 160 e. too lit.

6400 difference of the products
 $192 - 160 = 32$ the difference of the errors

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Question 2d continued.

Then, $6400 \div 32 = 200$ dollars their income.And $200 - 25 = 175$ dolls. A spends per annumAlso, $175 + 30 = 205$ dollars B spends per annum

3. Suppose A's 12
 Then B's is 15
 And C's ' 19

46
 100

Error 54 too little

 $54 \times 40 = 2160$ $30 \times 12 = 360$

2520 sum of the productsAnd $54 + 30 = 84$ sum of the errorsThen, $2520 \div 84 = 30$ A's share $30 + 3 = 33$ B's share $33 + 4 = 37$ C's share

Again, suppose A's 40
 Then B's is 43
 And C's ' 47

130
 100

Error 30 too much

4. Suppose A paid 100
 then B ' 1100
 and C ' 1200

2400
 10000

error 7600

Again, suppose A paid 200
 then B ' 1200
 and C ' 1400

2800
 10000

error 7200

Errors are alike, i. e. both too little

 $7600 \times 200 = 1520000$ $7200 \times 100 = 720000$

Diff. of the products, 800000 $7600 - 7200 = 400$ difference of the errorsThen, $800000 \div 400 = 2000$ dollars A paidAnd $2000 + 1000 = 3000$ dollars B paidAlso $2000 + 3000 = 5000$ dollars C paid

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5. Suppose first horse \$10	Again, sup. first horse \$20
50	50
<hr/>	<hr/>
2)60	2)70
<hr/>	<hr/>
The second horse 30	Then, second horse 35
50	50
<hr/>	<hr/>
80	85
10×3=30	20×3=60
<hr/>	<hr/>
Error too little 50	error too little 25
50×20=1000	50
25×10= 250	25
<hr/>	<hr/>
Diff. of the prod. 750	Diff. of the errors 25

Then, $750 \div 25 = 30$ dollars first horseAnd $\frac{30+50}{2} = 40$ dollars second horse

6. Suppose 20 body	Again, suppose 30 body
<hr/>	<hr/>
Then, $\frac{20}{2} + 9 = 19$ tail	Then, $\frac{30}{2} + 9 = 24$ tail
9 head	9 head
<hr/>	<hr/>
Head and tail=28	Head and tail 33
body=20	body 30
<hr/>	<hr/>
error 8 too little	error 3 too little
30×8=240	8—3=5 difference of the errors
20×3= 60	
<hr/>	
Then, $180 \div 5 = 36$ inches the body	
Diff. of pro. 180	And $\frac{36}{2} + 9 = 27$ tail
	9 head
	<hr/>

72 in. = 6 feet.

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7. Suppose he wrought 20 days, and was idle 20

Then, 20 days \times 20 cents = 40020 ' \times 10 ' = 200

 He would receive 200 cents
 500

error too little 300

Again, suppose he wrought 25 days, and was idle 15

Then, 25 days \times 20 cents = 50015 ' \times 10 ' = 150

 He would receive 350
 500

error 150 too little

 $25 \times 300 = 7500$ $20 \times 150 = 3000$ $300 - 150 = 150$ difference of the errors

Diff. of pro. 4500

Then, $4500 \div 150 = 30$ days, wroughtAnd $40 - 30 = 10$ days, idle

8. Suppose each had 300 dollars

Then, $300 + \frac{300}{4} = 300 + 75 = 375$ And $(300 - 225) \times 2 = 75 \times 2 = 150$

 Difference 225 error

Again, suppose each had 400 dollars

Then, $400 + \frac{400}{4} = 400 + 100 = 500$ And $(400 - 225) \times 2 = 175 \times 2 = 350$

 Difference 150 err.

Errors alike.

Now, $400 \times 225 = 90000$ And $300 \times 150 = 45000$

 Diff. of the products 4500
And $225 - 150 = 75$ difference of the errorsThen, $4500 \div 75 = 600$ dollars

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9. Suppose the parts to be 8 and 7	Again, suppose the parts to be 10 and 5
Then, $8 \times 4 = 32$	Then, $10 \times 4 = 40$
$7 \times 16 = 112$	$5 \times 16 = 80$
<hr/>	<hr/>
80 error	40 error

Errors alike.

$$10 \times 80 = 800 \quad 80 - 40 = 40 \text{ difference of the errors}$$

$$8 \times 40 = 320 \quad \text{Then, } 480 \div 40 = 12 \text{ the greater}$$

Diff. of pro. 480

And $15 - 12 = 3$ the less

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10. Suppose 1 o'clock

$$\text{Then, } (\frac{2}{13} \text{ of } 11) \text{ or } 1 = \frac{22-13}{13} = \frac{9}{13} \text{ error}$$

Again, suppose it to be two of the clock,

$$\text{Then, } (\frac{2}{13} \text{ of } 10) \text{ or } 2 = \frac{26-20}{13} = \frac{6}{13} \text{ error}$$

Errors unlike

$$\text{Now, } \frac{9}{13} \times 2 = \frac{18}{13}, \text{ and } \frac{6}{13} \times 1 = \frac{6}{13}$$

$$\text{Then, } \frac{18}{13} + \frac{6}{13} = \frac{24}{13} \text{ the sum of the products}$$

$$\text{And } \frac{9}{13} + \frac{6}{13} = \frac{15}{13} \text{ the sum of the errors}$$

$$\text{Lastly, } \frac{24}{13} \div \frac{15}{13} = \frac{24}{13} \times \frac{13}{15} = \frac{24}{15} = 1 \text{ hour } 36 \text{ minutes.}$$

PERMUTATION.

$$2. \quad 1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7 \times 8 \times 9 \times 10 \times 11 \times 12 = 479001600 \text{ changes}$$

$$10) 479001600 \text{ changes}$$

$$\begin{array}{r} \text{days hrs.} \quad 6,0) \quad 47900160 \\ 355 \quad 6 = 8766) \quad 798336(91 \text{ years} \\ \quad \quad \quad 78894 \end{array}$$

$$\quad \quad \quad 9396$$

$$\quad \quad \quad 8766$$

$$\quad \quad \quad \text{--- days w. d.}$$

$$24) 630 (26 = 3 \quad 5$$

$$\quad \quad 48$$

$$\quad \quad \quad 150$$

$$\quad \quad \quad 144$$

$$\quad \quad \quad 6 \text{ hours.}$$

Ans. 91 years 3 weeks 5 days 6 hours

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$$3. \quad 1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7 = 5040 \text{ days.}$$

$$\text{Then. } 5040 \div 365 = 13 \text{ years } 295 \text{ days}$$

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$$4. \quad 1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7 \times 8 \times 9 = 362880$$

$$5. \quad 1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7 \times 8 \times 9 \times 10 \times 11 \times 12 \times 13 \times 14 \times 15 \\ \times 16 \times 17 \times 18 \times 19 \times 20 \times 21 \times 22 \times 23 \times 24 \times 25 \times 26 = \\ 103291461126605635584000000$$

COMBINATION.

$$2. \quad \begin{array}{cccc} 4 & 11 & 7 & 4 \\ 24 \times 23 \times 22 \times 21 \times 20 \times 19 \\ \hline 1 \times 2 \times 3 \times 4 \times 5 \times 6 \end{array} = \\ 1 \times 23 \times 11 \times 7 \times 19 = 134596$$

$$3. \quad \begin{array}{ccccc} 5 & 4 & 13 & 5 & 3 \\ 20 \times 29 \times 28 \times 27 \times 26 \times 25 \times 24 \times 23 \\ \hline 1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7 \times 8 \end{array} = \\ 5 \times 23 \times 27 \times 13 \times 5 \times 23 = 5852925$$

ADDITION OF DUODECIMALS.

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$$2. \quad \begin{array}{cccccc} \text{feet} & \text{in.} & \text{"} & \text{'"} & \text{'''}} \\ 3780 & 9 & 4 & 7 & 9 \end{array}$$

SUBTRACTION OF DUODECIMALS.

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$$2. \quad 916 \text{ feet } 8 \text{ inches } 1 \text{ second } 8 \text{ thirds } 2 \text{ fourths}$$

$$3. \quad \begin{array}{cccc} & \text{feet} & \text{in.} & \text{"} & \text{'"} \\ \text{From} & 35 & 9 & 2 & 0 \\ \text{Take} & 24 & 10 & 5 & 4 \\ \hline \text{Diff.} & 10 & 10 & 8 & 8 \end{array}$$

$$4. \quad \begin{array}{cccc} & \text{feet} & \text{in.} & \text{"} & \text{'"} & \text{'''}} \\ \text{From} & 803 & 3 & 4 & 0 & 0 \\ \text{Take} & 70 & 3 & 7 & 10 & 5 \\ \hline \text{Diff.} & 732 & 11 & 8 & 1 & 8 \end{array}$$

MULTIPLICATION OF DUODECIMALS.

Case 1. Page 155.

<p>2. $\begin{array}{r} \text{ft. in.} \\ 9 \ 5 \\ 3 \ 11 \\ \hline 8 \ 7 \ 7 \\ 28 \ 3 \\ \hline \end{array}$</p> <p>square ft. 36 10 7</p>	<p>3. $\begin{array}{r} \text{ft. in.} \\ 7 \ 10 \\ 8 \ 11 \\ \hline 7 \ 2 \ 2 \\ 62 \ 8 \\ \hline \end{array}$</p> <p>sq. ft. 69 10 2</p>	<p>4. $\begin{array}{r} \text{ft. in. ''} \\ 8 \ 4 \ 6 \\ 2 \ 7 \ 4 \\ \hline 2 \ 9 \ 6 \\ 4 \ 10 \ 7 \ 6 \\ 16 \ 9 \ 0 \\ \hline \end{array}$</p> <p>square feet 21 10 5 0</p>
---	---	--

<p>5. $\begin{array}{r} \text{feet in.} \\ 5 \ 7 \\ 1 \ 10 \\ \hline 4 \ 7 \ 10 \\ 5 \ 7 \\ \hline \end{array}$</p> <p>square ft. 10 2 10</p>	<p>Then, 150 cents 10 square feet</p> <p>$\begin{array}{r l} 2 \text{ in.} & 1500 \\ 8 \text{ ''} & 25 \\ 2 \text{ ''} & 8\frac{1}{2} \\ & 2\frac{1}{12} \\ \hline & \\$15,35\frac{5}{12} \end{array}$</p>
--	---

<p>6. $\begin{array}{r} \text{ft. in.} \\ 7 \ 10 \\ 6 \ 8 \\ 5 \ 4 \\ \hline 19 \ 10 \\ 3 \ 11 \\ \hline 18 \ 2 \ 2 \\ 59 \ 6 \\ \hline 77 \ 8 \ 2 \\ 3 \\ \hline \end{array}$</p> <p>233 0 6 square feet 10*</p>	<p>Then, 233 square feet 14 cents</p> <p>$\begin{array}{r} 3262 \\ 6 \text{ is } \frac{1}{24} = \frac{7}{12} \\ \hline \\$32,62\frac{7}{12} \end{array}$</p>
--	---

Case 2. Page 156.

2.	<i>ft.</i> 76	<i>in.</i> 7×1 6	3.	<i>ft.</i> 127	<i>in.</i> 6×2 10	4.	<i>ft.</i> 184	<i>in.</i> 8×7 12
	459	6 3		1275	0 9		2216	0 10
	1378	6		11475	0		22160	0
<i>in.</i>	76	7	<i>in.</i>	255	0	<i>in.</i>	1292	8
6 is $\frac{1}{2}$ =	38	3 6	4 is $\frac{1}{2}$ =	42	6	6 is $\frac{1}{2}$ =	92	4
4 ' $\frac{1}{3}$ =	25	6 4		11772	6		23545	0
sq. ft.	1518	10 10				sq. feet		

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6.	<i>feet</i> 38	<i>in.</i> 11 10	7.	<i>feet.</i> 59	<i>in.</i> 9 4
	389	2 7		239	0 6
	2724	2		1434	0
6 in. is $\frac{1}{2}$ =	19	5 6	6 in. is $\frac{1}{2}$ =	29	10 $\frac{1}{2}$
2 ' ' $\frac{1}{3}$ =	6	5 10		9)1463	10 $\frac{1}{2}$
square feet	2750	1 4		162 yds.	5 ft. 10 $\frac{1}{2}$ in.
8.	<i>feet in.</i> 54 9=	<i>feet</i> 54,75	9.	<i>feet</i> 7	<i>in.</i> 6 3 3
	58 6=	58,5		1 10 6	
	27375			22 6	
	43800			24 4 6	
	27375			1' 10	
	9)3202,875			20 3 9 0	
	355,875 yards			24 4 6	
	15 cents				
	\$53,38125			square feet	44 8 3 0

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$$\begin{array}{l}
 10. \quad \begin{array}{ccccccc}
 \textit{ft. in.} & \textit{ft. in.} & \textit{ft. in.} & \textit{ft. in.} & \textit{ft. in.} & \textit{ft. in.} & \textit{ft. in.} \\
 (2 \ 10) \times (2 \ 4) \times (1 \ 9) = 11 \ 6 \ 10 \\
 (2 \ 10) \times (2 \ 6) \times (1 \ 3) = 8 \ 10 \ 3 \\
 (3 \ 6) \times (2 \ 2) \times (1 \ 8) = 12 \ 7 \ 8 \\
 (2 \ 10) \times (2 \ 8) \times (1 \ 9) = 13 \ 2 \ 8 \\
 (2 \ 10) \times (2 \ 6) \times (1 \ 9) = 12 \ 4 \ 9 \text{ '''} \\
 (2 \ 11) \times (2 \ 8) \times (1 \ 8) = 12 \ 11 \ 6 \ 8
 \end{array}
 \end{array}$$

 71 7 8 8

Or, 71,6435 square feet

Then, as $\begin{array}{c} \textit{ft. dolls.} \\ 40 : 20 \end{array} :: \begin{array}{c} \textit{sq. feet.} \\ 2 : 1 \end{array} :: 71,6435 : \$35,82 +$

To find a ship's tonnage.

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$$3. \quad \frac{64 \times 22 \times 10}{95} = 148 \frac{4}{9} \text{ tons}$$

$$4. \quad \frac{80 \times 26 \times 13}{95} = 284 \frac{12}{19} \text{ tons}$$

THE CARPENTERS' OR SLIDING RULE.

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1st. *To multiply numbers together.*

2. Set 1 on B to 12 on A, then against 16 on B stands 192 the product on A.

3. Set 1 on B to 35 on A, then against 19 on B stands 665 the product on A.

4. Set 1 on B to 54 on A, then against 270 on B stands 14580 the product on A.

2d. *Division of numbers by the Carpenters' rule.*

2. Set the divisor 19 on B to the dividend 665 on A, then against 1 on B stands 35 the quotient on A.

3. Set 27 on B to 396 on A, then against 1 on B stands 14,6 the quotient on A.

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4. Set 42 on B to 741 on A, then against 1 on B stands 17,6 the quotient on A.

5. Set 24 on B to 7680 on A, then against 1 on B stands 320 the quotient on A.

3d. *To square numbers by the Carpenters' rule.*

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2. Having set 1 on C to 10 on D, then against 30 on D stands 900 on C.

3. Having the rule set as above, against 35 on D you will find 1225 its square on C.

4. Also against 40 on D stands 1600 its square on C.

4th. *To find a fourth proportional to three numbers.*

2. Set the first term 25 on B to 75 the second term on A, then against 100 the third term on B stands 300 the fourth term on A.

3. Set 27 on B to 20 on A, then against 73 on B stands $54\frac{2}{7}$ on A.

5th. *To extract the square root of any number by the
[Carpenters' rule.]*

2. Having set 1 on C to 10 on D, against 529 on C stands 23 its root on D.

3. Being set as in the last example, against 900 on C stands 30 the root on D.

4. The rule set as before, against 300 on C stands 17,3 the root on D.

MEASURING OF BOARDS AND TIMBER.

Page 162.

1st. *To find the superficial content of a board or plank.**foot in.*

$$\begin{array}{r}
 2. \quad 1 \quad 2 \\
 \quad 12 \quad 6 \\
 \hline
 \quad \quad 7 \quad 0 \\
 \quad 14 \quad 0 \\
 \hline
 \end{array}$$

feet 14 7

Or, by the sliding rule.

As 12 on B : 14 on A ::

12 ft. 6 in. on B : 14 ft.

7 in. on A*.

$$3. \quad 13\frac{1}{2} + 13\frac{1}{2} + 14\frac{1}{2} + 18 + 11\frac{1}{2} = 70\frac{3}{4} = 2\frac{83}{4} \text{ inches}$$

$$\text{But } 2\frac{83}{4} \text{ inches} = \frac{283}{4 \times 12} \text{ feet } 2\frac{83}{48} \text{ feet}$$

$$\text{And } 17\frac{1}{2} \text{ feet} = \frac{35}{2} \text{ feet}$$

$$\text{Then, } 2\frac{83}{48} \times \frac{35}{2} \times 3 \text{ cts.} = \frac{9905 \times 3}{96} = \frac{9905}{32} = 3\text{d. } 09\frac{17}{32} \text{ cts.}$$

2d. *Having the breadth of a board or plank in inches, to find how much in length will make a foot, &c.*

Page 163.

$$2. \quad 144 \div 23 = 6,26 \text{ inches}$$

$$3. \quad 1\frac{1}{2} \text{ yards} = 1944 \text{ square inches}$$

$$\text{Then, } 1944 \div 26 = 74,7692 \text{ inches} = 6,2307 \text{ feet}$$

3d. *To find the solid content of square or four sided timber.*

Page 164.

$$2. \quad \frac{15 \text{ in.} \times 15 \text{ in.} \times 18 \text{ ft.}}{144} = 2\frac{25}{8} = 28\frac{1}{8} \text{ feet}$$

$$3. \quad \frac{25 \text{ in.} + 9 \text{ in.}}{2} = 17 \text{ inches, the quarter girt}$$

$$\text{Then, } \frac{17 \text{ in.} \times 17 \text{ in.} \times 20 \text{ ft.}}{144} = 40,1388 \text{ feet, \&c.}$$

* The operation by the sliding rule is omitted after this, it being presumed that the directions in the W. Calculator make it superfluous to work more examples.

Page 164.

$$4. \frac{32\text{in.}+10\text{in.}}{2} = 21 \text{ inches the mean breadth}$$

$$\text{And } \frac{20\text{in.}+6\text{in.}}{2} = 13 \text{ inches the mean breadth}$$

$$\text{Then, } \frac{21 \times 13 \times \cancel{18}}{\cancel{144} \atop 8} = 27^3 = 34,125 \text{ feet}$$

4th. *To find the solid content of round timber.*

Page 165.

$$2. \frac{14+2}{2 \times 4} = 2 \text{ the quarter girt}$$

$$\text{Then, } 2 \times 2 \times 24 = 96 \text{ feet.}$$

Page 166.

$$3. 24 \text{ inches} = 2 \text{ feet}$$

$$\text{Then, } 2 \text{ feet} \times 2 \text{ feet} \times 18 \text{ feet} = 72 \text{ feet.}$$

$$4. \frac{11 \text{ ft. } 4 \text{ in.} + 2 \text{ ft. } 8 \text{ in.}}{2 \times 4} = 1^4_8 = 1,75 \text{ feet}$$

$$\text{Then, } 1,75 \text{ ft.} \times 1,75 \text{ ft.} \times 21 \text{ ft.} = 64,3125 \text{ feet}$$

$$\begin{aligned} 5. \quad 24 \times \left(\frac{8}{4}\right)^2 &= 24 \times 4 &= 96 \\ 14\frac{1}{2} \times \left(3\frac{1}{4}\right)^2 &= 14,5 \times 6,2015625 = 8,9922 + \\ 17\frac{1}{4} \times \left(6\frac{3}{4}\right)^2 &= 17,25 \times 2,4649 &= 42,5195 \end{aligned}$$

sum 147,5117 feet

CARPENTERS' AND JOINERS' WORK.

Page 168.

$$2. \frac{(53\text{ft. } 6\text{in.}) \times (47\text{ft. } 9\text{in.})}{100} = \frac{53,5 \times 47,75}{100} = 25^{\text{sq. feet.}} 54,625$$

$$3. \frac{(36 \text{ ft. } 3 \text{ in.}) \times (16 \text{ ft. } 6 \text{ in.})}{100} = \frac{36,25 \times 16,5}{100} = 5,98125^{\text{squares}}$$

$$\text{Then, } 5,98125 \text{ squares} \times 4 \text{ d. } 50 \text{ c.} = 26 \text{ d. } 91 \text{ c. } 5,625 \text{ m.}$$

Page 168.

4. $35 \text{ ft.} \times 30 \text{ ft.} = 1050 \text{ square feet}$
 $(4 \text{ ft. } 6 \text{ in.}) \times 6 \text{ ft.} = 4,5 \times 6 = 27 \text{ square ft. fire place}$
 $(10 \text{ ft. } 6 \text{ in.}) \times 8 \text{ ft.} = 10,5 \times 8 = 84 \text{ ' ' stairs}$

111 feet

Then, $\frac{1050 - 111}{100} = 9,39 \text{ squares}$

Lastly, $9,39 \text{ squares} \times 3 \text{ d. } 75 \text{ c.} = 35 \text{ d. } 21 \text{ c. } 2,5 \text{ ms.}$

$$5. \frac{\begin{array}{c} \text{ft. in.} \\ (82 \ 6) \end{array} \times \begin{array}{c} \text{ft. in.} \\ (12 \ 3) \end{array}}{100} = \frac{\begin{array}{c} \text{ft.} \ \text{ft.} \\ 82,5 \times 12\frac{3}{4} \end{array}}{100} = 10 \ 10,625 \text{ sq. feet}$$

$$6. \frac{(91 \text{ ft. } 9 \text{ in.}) \times (11 \text{ ft. } 3 \text{ in.})}{100} = \frac{91,75 \times 11\frac{3}{4}}{100} = 10,321875 \text{ squares}$$

Then, $10,321875 \times 4 \begin{array}{c} \text{squares} \\ \text{dolls. cts.} \\ \text{d. cts.} \\ \text{mills} \end{array} = 46 \ 44 \ 8,4375$

Page 169.

$$8. \begin{array}{r} \text{ft. in.} \\ 2)30 \ 6 \\ \underline{15 \ 3} \end{array}$$

$45 \ 9 = 45,75 \text{ feet.}$ And $52 \text{ feet } 8 \text{ in.} = 52\frac{2}{3} \text{ feet}$

Then, $\frac{45,75 \times 52\frac{2}{3}}{100} = 24,095 \text{ squares}$

Lastly, $24,095 \text{ sq.} \times 140 \text{ cts.} = 33 \text{ dolls. } 73 \text{ cts. } 3 \text{ mills}$

$$9. \begin{array}{r} \text{ft. in.} \\ 20 \ 6 \\ \frac{1}{2} = 10 \ 3 \end{array}$$

$30 \ 9 = 30,75 \text{ feet.}$ And $40 \text{ feet } 6 \text{ inches} = 40,5 \text{ feet}$

Then, $\frac{30,75 \times 40,5}{100} = 12,45375 \text{ squares}$

Lastly, $12,45375 \text{ squares} \times 225 \text{ cts.} = 28 \text{ dollars } 2 \text{ cents } +$

Page 170.

$$11. (137 \text{ ft. } 6 \text{ in.}) \times (16 \text{ ft. } 3 \text{ in.}) = 137,5 \times 16\frac{3}{4} = 2234,375 \text{ square feet}$$

Then, $2234,375 \text{ feet} \div 9 = 248 \text{ yards } 2,375 \text{ feet}$

Page 170.

$$12. (69 \text{ ft. } 9 \text{ in.}) \times (6 \text{ ft. } 3 \text{ in.}) = 69,75 \times 6\frac{1}{4} = 435,9375$$

$$\frac{1}{2} \text{ work} = 217,96875$$

$$9)653,90625$$

square yards 72,65625

$$13. (83 \text{ ft. } 8 \text{ in.}) \times (12 \text{ ft. } 6 \text{ in.}) = 83\frac{2}{3} \times 12,5 = 1045,83\frac{1}{3}$$

$$(7 \text{ ft. } 8 \text{ in.}) \times (2 \text{ ft. } 6 \text{ in.}) \times 1\frac{1}{2} = 7\frac{2}{3} \times 2,5 \times 1,5 = 28,75 \text{ wind.}$$

$$(3 \text{ ft. } 6 \text{ in.}) \times 7 \text{ ft.} \times \frac{1}{2} = 3,5 \times 7 \times ,5 = 12,25 \text{ door}$$

$$9)1086,83\frac{1}{3}$$

square yards 120,7 $\frac{16}{27}$

$$\text{Then, } 120,7\frac{16}{27} \text{ yds.} \times 80 \text{ cts.} = 96 \text{ dolls. } 60 \text{ cts. } 7\frac{11}{27} \text{ mills}$$

BRICKLAYERS' WORK.

Page 173.

$$2. \begin{array}{ccc} \text{ft. in.} & \text{ft. in.} & \\ (57 \ 3) & \times (24 \ 6) & \times 5 = 57,25 \times 24,5 \times 5 = 7013,125 \end{array} \quad \text{half brick}$$

$$\text{Then, } 3)7013,125$$

$$9)2337,708\frac{1}{3} \text{ standard thickness}$$

$$259,745 + \text{square yards}$$

$$\text{Or, } 2337,708\frac{1}{3} \div 272\frac{1}{4} = 8,5866 \text{ rods}$$

$$3. \begin{array}{ccc} \text{feet in.} & \text{feet in.} & \\ (245 \ 9) & \times (16 \ 6) & \times 5 = 245,75 \times 16,5 \times 5 = 20274,375 \end{array}$$

$$\text{And } 20274,375 \div 3 = 6758,125 \text{ standard thickness}$$

$$\text{Then, } \frac{6758,125}{272,25} = 24 \text{ rods } 3 \text{ quarters } 19,945 \text{ feet}$$

$$4. (45 \text{ ft.} \times \frac{15}{2} \text{ ft.} \times 5) \div 3 = 562,5 \text{ standard thickness}$$

$$\text{Then, } 562,5 \div 272,25 = 2 \text{ rods } 18 \text{ feet}$$

MASONS' WORK.

Page 175.

$$2. \begin{array}{ccc} \text{feet in.} & \text{feet in.} & \\ (53 \ 6) & \times (12 \ 3) & \times 2 = 53,5 \times 12\frac{1}{2} \times 2 = 1310,75 \text{ feet} \end{array}$$

$$\text{Then, } 1310,75 \div 24,75 = 52,9595 \text{ rods}$$

Page 175.

$$3. (107 \text{ ft. } 9 \text{ in.}) \times (20 \text{ ft. } 6 \text{ in.}) = 2208 \text{ feet } 10\frac{1}{2} \text{ inches}$$

$$4. \frac{(112 \text{ ft. } 3 \text{ in.}) \times (16 \text{ ft. } 6 \text{ in.})}{63} = \frac{112,25 \times 16,5}{63} = 29 \frac{\text{rods}}{25,125} \frac{\text{feet}}{125}$$

$$5. (5 \text{ ft. } 7 \text{ in.}) \times (1 \text{ ft. } 10 \text{ in.}) = \frac{67}{12} \times \frac{22}{12} = \frac{1474}{144} = \frac{737}{72} \text{ feet}$$

$$\text{Then, } \frac{737}{72} \times 80 \text{ cts.} = \frac{737 \times 10}{9} = 818\frac{8}{9} \text{ cts.} = 8 \text{ dolls. } 18\frac{8}{9} \text{ cts.}$$

PLASTERERS' WORK.

Page 177.

$$2. \frac{\begin{smallmatrix} \text{feet} & \text{in.} \\ (141 & 6) \end{smallmatrix} \times \begin{smallmatrix} \text{feet} & \text{in.} \\ (11 & 3) \end{smallmatrix}}{9} = \frac{141,5 \times 11,25}{9} = 176,875 \frac{\text{yards}}{9}$$

$$3. (22 \text{ ft. } 7 \text{ in.}) \times (13 \text{ ft. } 11 \text{ in.}) = \frac{271}{12} \times \frac{167}{12} = \frac{45257}{144} \text{ feet}$$

$$\text{But, } \frac{45257}{144} \text{ feet} = \frac{45257}{144 \times 9} = \frac{45257}{1296} \text{ yards}$$

$$\text{Then, } \frac{45257}{1296} \times 15 \text{ cts.} = \frac{26285}{432} = 5 \text{ dolls. } 23 \text{ cts. } 8\frac{17}{16} \text{ ms.}$$

$$4. (20 \text{ ft. } + 14 \text{ ft. } 6 \text{ in.}) \times 2 = 69 \text{ feet round the room}$$

$$69 \text{ ft.} \times (10 \text{ ft. } 4 \text{ in.}) = 713 \text{ sq. feet in the walls}$$

$$(4 \text{ ft. } 4 \text{ in.}) \times 4 \text{ ft.} = 17 \text{ ft. } 4 \text{ inches fire place}$$

$$(3 \text{ ft. } 2 \text{ in.}) \times 6 \text{ ft.} \times 2 = 38 \text{ ft. } 0 \quad \text{two windows}$$

$$\text{Sum } 55 \text{ ft. } 4 \text{ in.} = 55\frac{1}{3} \text{ feet}$$

$$713 \text{ ft.} - 55\frac{1}{3} = 657\frac{2}{3} \quad \text{Lastly, } 657\frac{2}{3} \div 9 = 73\frac{2}{7}$$

$$5. (14 \text{ ft. } 5 \text{ in.} + 13 \text{ ft. } 2 \text{ in.}) \times 2 = 55 \text{ ft. } 2 \text{ inches round}$$

$$\text{Then, } (55 \text{ ft. } 2 \text{ in.}) \times (9 \text{ ft. } 3 \text{ in.}) = 510 \text{ } 3 \text{ } 6 \text{ } \frac{\text{ft. in.}''}{7 \text{ ft.} \times 4 \text{ ft.} = 28 \text{ } 0 \text{ } 0}$$

$$9) 482 \text{ } 3 \text{ } 6$$

Rendering 53 y. 5 ft. 3 in. 6 s.

$$\begin{smallmatrix} \text{ft. in.} & & \text{in.} & \text{ft. in.} \\ 14 & 5 & \text{less } 10 & = 13 \text{ } 7 \end{smallmatrix} \text{ And } 13 \text{ ft. } 2 \text{ in.} - 10 \text{ in.} = 12 \text{ ft. } 4 \text{ in.}$$

$$\text{Then, } \frac{(13 \text{ ft. } 7 \text{ in.}) \times (12 \text{ ft. } 4 \text{ in.})}{9 \text{ feet}} = 18 \text{ yds. } 5 \text{ ft. } 6 \text{ in. } 4''$$

Page 177.

$$6. \frac{\overset{\text{feet in.}}{(105 \ 6)} \times \overset{\text{feet in.}}{(275 \ 5)}}{9 \text{ feet}} = \frac{105,5 \times 275 \frac{5}{12}}{9} = \frac{\text{square yards}}{9} = 3228,4 \frac{103}{108}$$

Then, $3228,4 \frac{103}{108}$ sq. yds. $\times 12$ cts. = 387 d. 41 c. $9 \frac{4}{9}$ m.

$$7. \quad (30 \text{ ft. } 6 \text{ in.} + 24 \text{ ft. } 9 \text{ in.}) \times 2 = 110 \overset{\text{feet in.}}{6} = 110,5 \text{ round}$$

$$110,5 \text{ ft.} \times 10 \text{ ft.} = 1105 \text{ square feet in the walls}$$

$$30,5 \text{ ' } \times 24 \frac{3}{4} \text{ ' } = 754,875 \text{ in the ceiling}$$

$$9)1859,875$$

$$206,652 \frac{7}{9} \text{ square yards}$$

$$2 \text{ cents}$$

$$\$4,13305 \frac{5}{9}$$

Or, 4 dollars 13 cents 3 mills.

PAVERS' WORK.

Page 178.

$$2. \frac{(35 \text{ ft. } 4 \text{ in.}) \times (8 \text{ ft. } 3 \text{ in.})}{9} = \frac{35 \frac{1}{2} \times 8,25 \text{ square yards}}{9} = 32,3 \frac{8}{9}$$

Then, $32,3 \frac{8}{9}$ sq. yds. $\times 28$ cts. = 9 dolls. 06 cts. $8 \frac{8}{9}$ mills

$$3. \quad (27 \text{ ft. } 10 \text{ in.}) \times (14 \text{ ft. } 9 \text{ in.}) = 27 \frac{5}{6} \times 14,75 = 410,54 \frac{1}{6} \text{ s. f.}$$

$$410,54 \frac{1}{6} \div 9 = 45,61 \frac{3 \frac{1}{4}}{5 \frac{1}{4}} \text{ square yards}$$

$$\text{Then, } 45,61 \frac{3 \frac{1}{4}}{5 \frac{1}{4}} \times 38 \text{ cts.} = 1733,39 \frac{2 \frac{2}{7}}{2 \frac{2}{7}} \text{ cts.} = 17 \overset{\text{d. cts. ms.}}{33 \ 3,9} +$$

$$4. \quad 45 \text{ feet} - 5 \text{ feet } 3 \text{ inches} = 39 \text{ feet } 9 \text{ inches}$$

$$\frac{63 \text{ ft.} \times (5 \text{ ft. } 3 \text{ in.})}{9} = 7 \times 5 \frac{1}{4} \text{ feet} = 36 \frac{3}{4} \text{ sq. yds. broad stones}$$

$$\frac{63 \text{ ft.} \times (39 \text{ ft. } 9 \text{ in.})}{9} = 7 \times 39 \frac{3}{4} \text{ ft.} = 278 \frac{1}{4} \text{ sq. yds. pebbles}$$

$$\text{Then, } 36 \frac{3}{4} \text{ square yards} \times 36 \overset{\text{dolls. cts.}}{\text{cts.}} = 13 \ 28$$

$$278 \frac{1}{4} \text{ ' } \times 30 \text{ ' } = 83 \ 47 \frac{1}{2}$$

$$\text{Sum } \$96 \ 70 \frac{1}{2}$$

PAINTERS' WORK.

Page 179.

	<i>ft.</i>	<i>in.</i>	<i>"</i>	
2. (74 ft. 10 in.) × (11 ft. 7 in.) =	866	9	10	
(7 ft. 6 in.) × (3 ft. 9 in.) =	28	1	6	door
(6 ft. 8 in.) × (3 ft. 4 in.) × 5 =	111	1	4	windows
(22 ft. 8 in.) × (1 ft. 2 in.) × 5 =	132	2	8	breaks

	1138	3	4	
(6 ft. 9 in.) × 5 feet =	33	9	0	chimney
	1104	6	4	<i>feet</i>
				$= 1104\frac{1}{3}\frac{9}{8}$

And $1104\frac{1}{3}\frac{9}{8} \div 9 = 122\frac{2}{3}\frac{3}{4}$ square yardsThen, $122\frac{2}{3}\frac{3}{4}$ s. yds. × $8\frac{1}{2}$ cts. = 10 dolls. 43 cts. $1\frac{2}{3}\frac{1}{4}$ ms.

3. (20 ft. + 14 ft. 6 in.) × 2 = 69 feet round
 69 ft. × (10 ft. 4 in.) = $69 \times 10\frac{1}{4} = 713$ square feet
 (4 ft. 4 in.) × 4 ft. = $4\frac{1}{2} \times 4 = 17\frac{1}{2}$ feet fire place
 (3 ft. 2 in.) × 6 ft. × 2 = $3\frac{1}{6} \times 6 \times 2 = 38$ feet windows

Sum $55\frac{1}{2}$

Then, $\frac{713 - 55\frac{1}{2}}{9} = \frac{657\frac{2}{3}}{9} = 73\frac{2}{27}$ square yards.*

Page 180.

	<i>ft.</i>	<i>in.</i>	<i>"</i>	
4. (24½ ft. + 16¼ ft.) × 2 × 12¼ ft. =	1039	1	6	
(3 ft. 6 in.) × 7 feet =	24	6	0	door
(7 ft. 9 in.) × (3 ft. 6 in.) × 2 =	54	3	0	w. shut.
24 ft. × (1 ft. 3 in.) × 2 =	60	0	0	breaks

	1177	10	6
(5 ft. 6 in.) × 5 feet =	27	6	0

	1150	4	6
--	------	---	---

9)1150	$\frac{3}{8}$
--------	---------------

	127	$\frac{5}{7}\frac{9}{2}$
--	-----	--------------------------

Then, $127\frac{5}{7}\frac{9}{2} \times 6$ cts. = 7 dolls. 66 cts. $9\frac{1}{6}$ ms.

* The same as question 4, plasterers' work.

GLAZIERS' WORK.

Page 181.

$$2. (7 \text{ ft. } 3 \text{ in.}) \times (3 \text{ ft. } 5 \text{ in.}) = 24 \text{ square feet } 9 \text{ in. } 3 \text{ sec.}$$

$$3. (6 \text{ ft. } 11 \text{ in.} + 5 \text{ ft. } 4 \text{ in.} + 4 \text{ ft. } 3 \text{ in.}) \times (3 \text{ ft. } 6 \text{ in.}) \times 7 = 16,5 \times 3,5 \times 7 = 404,25 \text{ square feet}$$

$$\text{Then, } 404,25 \text{ sq. ft.} \times 14\frac{1}{2} \text{ cts.} = 58 \text{ d. } 61 \text{ cts. } 6,25 \text{ ms.}$$

$$4. (12 \text{ ft. } 6 \text{ in.}) \times \left(\frac{16 \text{ ft. } 9 \text{ in.}}{2} \right) = 12,5 \times 8,375 = 104,6875 \text{ square feet}$$

$$\text{Then, } 104,6875 \text{ sq. ft.} \times 10 \text{ cts.} = 10 \text{ d. } 46 \text{ cts. } 8\frac{3}{4} \text{ ms.}$$

$$5. (14 \text{ ft. } 6 \text{ in.}) \times (4 \text{ ft. } 9 \text{ in.}) = 63 \text{ sq. ft. } 10 \text{ in. } 6 \text{ sec.}$$

$$6. (7 \text{ ft. } 10 \text{ in.} + 6 \text{ ft. } 8 \text{ in.} + 5 \text{ ft. } 4 \text{ in.}) \times (3 \text{ ft. } 11 \text{ in.}) \times 9 = 19\frac{5}{8} \times 3\frac{1}{2} \times 9 = \frac{119}{6} \times \frac{47}{12} \times 9 = 5\frac{59}{8} = 699\frac{1}{8} \text{ square feet}$$

$$\text{Then, } 699\frac{1}{8} \text{ square feet} \times 14 \text{ cents} = 97 \text{ dollars } 87\frac{3}{4} \text{ cents}$$

MEASUREMENT OF GROUND.

1st. *To find the content of a square piece of ground.*

Page 182.

$$2. 35 \times 2 = 70 \text{ perches}$$

$$\text{Then, } 70 \times 70 = 4900 \text{ square feet} = 30 \text{ A. } 2. \text{ R. } 20 \text{ P.}$$

$$3. 16\frac{1}{2} \times 16\frac{1}{2} = 16,5 \times 16,5 = 272,25 = 1 \text{ sq. perches } 2 \text{ A. } 32\frac{1}{4} \text{ P.}$$

2d. *To find the content of an oblong piece of ground, called a parallelogram.*

Page 183.

$$2. \frac{120 \text{ perches} \times 84 \text{ perches}}{160 \text{ perches}} = 63 \text{ acres}$$

Page 183.

3. $\frac{240 \times 120}{16\frac{1}{2} \times 16\frac{1}{2}} = \frac{28800}{272\frac{1}{4}} = 105$ perches $213\frac{3}{4}$ feet.

But, 105 per. $213\frac{3}{4}=2$ rods 25 perches $213\frac{1}{4}$ feet.

3d. *To find the content of a triangular piece of ground.*

Page 184.

2. $75 \times \frac{5}{2} = 75 \times 25 = 1875$ per. = 11 A. 2 R. 35 P.

3. $120 \times \frac{8}{3} = 120 \times 42 = 5040$ per. = 31 acres 2 roods

A. R. dolls.

dolls. cts.

Then, $(31\ 2) \times 45 = 31,5 \times 45 = 1417\ 50$

4. $140 \text{ ft.} \times \frac{70}{2} \text{ ft.} = 140 \times 35 = 4900 \text{ square feet}$

Then $4900 \div 9 = 544$ yards 4 feet.

4th. To find the content of a piece of ground, in the form of an oblique parallelogram.

Page 185.

2. $(80 \times 24) \div 160 = 12$ acres

5th. *To find the content of a piece of ground bounded by four sides, none of which are parallel or equal.*

Page 186.

$$2. \quad \frac{120 \times (48 + 24)}{2} = 4320 \text{ perches} = 27 \text{ acres}$$

6th. *To find the area of a piece of ground lying in a circle, or ellipsis.*

Page 187.

perches *A. R. P.*

$$2. \quad 30 \times 20 \times,7854 = 471,24 = 2 \quad 3 \quad 31,24$$

3. $160 \times 160 \times .7854 = 20106.24$ square feet.

But, $20106,24 \div 9 = 2234,02\frac{2}{3}$ square feet.

GAUGING.

Page 189.

$$2. \quad 28 + \frac{2}{3}(24 - 18) = 18 + 4 = 22 \text{ mean diameter}$$

$$\text{Then, } \frac{22 \times 22 \times 24}{\cancel{24} \times 49} = \frac{1936}{49} = 39\frac{25}{49} \text{ gallons}$$

$$3. \quad 28 + \frac{2}{3}(36 - 28) = 28 + 5\frac{1}{3} = 33\frac{1}{3} \text{ mean diameter}$$

$$\text{Then, } \frac{33\frac{1}{3} \times 33\frac{1}{3} \times 40}{294} = \frac{100 \times 100 \times \cancel{40}}{9 \times \cancel{24} \times 147} = \frac{200000}{1323} = 151\frac{227}{1323} \text{ gallons}$$

$$4. \quad 15 + \frac{2}{3}(18 - 15) = 15 + 2 = 17 \text{ mean diameter}$$

$$\text{Then, } \frac{17 \times 17 \times 29}{359} = \frac{8381}{359} = 23\frac{124}{359} \text{ gallons}$$

$$5. \quad 18 + \frac{2}{3}(22 - 18) = 18 + 2\frac{2}{3} = 20\frac{2}{3} \text{ mean diameter}$$

$$\text{Then, } \frac{20\frac{2}{3} \times 20\frac{2}{3} \times 36}{359} = \frac{62 \times 62 \times \cancel{36}}{\cancel{6} \times 359} = \frac{15376}{359} = 42\frac{298}{359} \text{ gallons}$$

MECHANICAL POWERS.

1st. THE LEVER.

Page 190.

As 1 inch : 20 inches :: 5 lb. : 100 pounds the answer

2d. THE WHEEL AND AXLE.

Page 191.

As 60 inches (=5 lb.) : 6 inches :: 10 lb. : 1 lb.

PROMISCUOUS QUESTIONS.

Page 192.

Quest. 1. $2578 + 2578 = 5156$

2. $14676 - 1^4 \frac{6}{4} 76 = 14676 - 3669 = 11007$

3. $1468 - (461 + 581) = 1468 - 1042 = 426$

4. $\frac{1}{3}$ of 100 cents $= 33\frac{1}{3}$ cents

$\frac{1}{2}$ of $\frac{1}{3} = \frac{1}{6}$ of 100 cts. $= 16\frac{2}{3}$:

Sum 50 cents

5. $1080 \div 45 = 24$ the number required

6. $(476)^2 \div \frac{4}{2} 76 = \frac{2^2 6^5 7^6}{2^3 8} = 952$

7. Suppose one side of the square to consist of 100 men

Then, $100^2 + 231 = 10231$ the whole number of men

And $101^2 - 44 = 10157$ the whole of the men

74 error too little

Again, suppose the side of the square to have 120 men

Then, $120^2 + 231 = 14631$ the whole number of men

And $121^2 - 44 = 14597$ the whole number of men

34 error too little

Errors alike.

Then, $\frac{(120 \times 74) - (100 \times 34)}{74 - 34} = \frac{5480}{40} = 137$ men on one side

Lastly, $(137)^2 + 231$, or $(138)^2 - 44 = 19000$ men

8. $113 \times 147 - 21^3 = 16611 - 9261 = 7350$

9. $\frac{2}{3}$ of $\frac{3}{8} = \frac{2}{8} = \frac{1}{4}$ then, as $\frac{1}{4} : 1260 \text{ d.} :: 1 : 5040 \text{ dolls.}$

10. $3500 - 2500 = 1000$ dollars

Then, 2500 dollars } $\frac{\text{dolls.}}{8 \text{ years}} \left\{ \begin{array}{l} 100 \text{ dollars} \\ 1 \text{ year} \end{array} \right.$

Lastly, $\frac{40 \times 1000 \times 100}{2500 \times 8} = 5$ per cent.

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$$11. \text{ As } \frac{2}{3} : 210 :: 1 : \frac{210 \times 3}{2} = \$315 \text{ elder brother's por.}$$

$$\text{Now, } 315 \times 3 \times 2 = 1890 \text{ dollars}$$

$$12. (650 - 130) \times 400 = 520 \text{ d. } \times 4 \text{ dolls.} = 2080 \text{ dolls.}$$

$$13. 17 + 8 + 46 + (20 \times 2) = 111 \text{ years}$$

$$14. 1000 - (350 + 400) = 250 \text{ dollars C's share}$$

$$\text{dolls. } 250 : 500 \text{ as } 1 : 2 :: 350 : 700 \text{ A put in}$$

$$\text{And, as } 1 : 2 :: 400 \text{ dolls.} : 800 \text{ dolls. B's cloth is worth}$$

$$15. \frac{1}{3} \text{ of } 2720 = 544 \text{ dollars the captain's share}$$

$$\text{Then, } \frac{2720 - 544}{160} = \frac{2176}{160} = 13 \text{ d. } 60 \text{ cts. a sailor's share}$$

$$16. \text{ As } 6 : 100 :: 972 \text{ dolls.} : 16200 \text{ dolls. her portion}$$

$$\text{And, as } \frac{3}{5} : 16200 \text{ dollars} :: 1 : 27000 \text{ dollars}$$

$$\text{Then, } 27000 \div 3 = 9000 \text{ d. int. of the father's estate 1 year}$$

$$\text{dolls. } 9000 : 150000 \text{ the father's estate}$$

$$\text{Lastly, as } 6 : 100 :: 9000 : 150000 \text{ the father's estate}$$

$$17. (4 \text{ ft. } 6 \text{ in.}) \times (2 \text{ ft. } 9 \text{ in.}) \times (3 \text{ ft. } 4 \text{ in.}) = 41 \text{ sq. ft. } 3 \text{ in.}$$

$$18. \frac{1}{9} + \frac{5}{6} = \frac{2+15}{18} = \frac{17}{18} \text{ and } 1 - \frac{17}{18} = \frac{1}{18}$$

$$\text{Then, as } \frac{1}{18} : 12 :: 1 : 12 \times 18 = 216 \text{ feet}$$

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$$19. \frac{112 \times \frac{4}{7}}{3} = \frac{64}{3} = 21\frac{1}{3} \text{ years}$$

$$20. \text{ As } \frac{9}{20} (= \frac{3}{4} \text{ of } \frac{3}{5}) : 1710 :: 1 : \frac{1710 \times 20}{9} = 3800 \text{ dolls.}$$

$$21. 63^2 \times (\frac{63}{2})^2 = 3969 \times 992,25 = 3938240,25 \text{ product}$$

$$\text{And } (63 \times \frac{63}{2}) - (63 + \frac{63}{2}) = 1984,5 - 95,5 = 1890 \text{ diff.}$$

*mi.**day miles**da. h. min.*

$$22. \text{ As } 68 (= 34 \times 2) : 1 :: 2000 : \frac{2000}{68} = 29 \text{ } 9 \text{ } 52\frac{16}{17}$$

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$$23. \begin{array}{c} \text{lb. times} \quad \text{lb.} \quad \text{C. qr. lb.} \\ 6 : 2 :: 885 (=7 \frac{3}{4} 17) : \frac{885 \times 2}{6} = 295 \text{ times} \end{array}$$

$$24. \text{ Suppose } 1, \text{ then } 1 + \frac{2}{3} = \frac{5}{3} \text{ sum}$$

$$\text{And, as } \frac{5}{3} : 1 :: 20 : \frac{20 \times 3}{5} = 12$$

$$25. 21 \times \frac{3}{4} = \frac{63}{4} = 15 \frac{3}{4}$$

$$26. \frac{3}{4} \div 15 = \frac{3}{4} \times \frac{1}{15} = \frac{3}{60} = \frac{1}{20}$$

$$27. \frac{3}{5} + \frac{1}{8} = \frac{24+5}{40} = \frac{29}{40}$$

$$28. \text{ Suppose the number to be } 6$$

$$\text{Then, } 6 \times 3 - 8 = 10 \text{ the whole of his money}$$

$$\text{And, } 6 \times 2 + 3 = 15 \text{ the whole of his money}$$

$$\text{—}$$

$$5 \text{ error}$$

$$\text{Again, suppose } 10 \text{ to be the number}$$

$$\text{Then, } 10 \times 3 - 8 = 22 \text{ his money}$$

$$\text{And, } 10 \times 2 + 3 = 23 \text{ his money}$$

$$\text{—}$$

$$1 \text{ error}$$

Errors alike.

$$\text{Now, } \frac{5 \times 10 - 6 \times 1}{5 - 1} = \frac{44}{4} = 11 \text{ children}$$

$$29. \begin{array}{l} \text{Inverse } 100 \text{ dollars} \} \text{ year } \{ 500 \text{ dollars inverse} \\ \quad \quad \quad 6 \text{ dollars} \} \quad 1 \} 500 \text{ dollars} \end{array}$$

$$\text{Then, } \frac{500 \times 100}{6 \times 500} = \frac{100}{6} = 16 \text{ years } 8 \text{ months}$$

$$30. \text{ Suppose the number to be } 100$$

$$\text{Then, } \frac{100}{2} + 15 + \frac{100}{3} + 10 = 108 \frac{1}{6} \text{ the members}$$

$$\text{But, } 108 \frac{1}{6} - 100 = 8 \frac{1}{6} \text{ error too little}$$

$$\text{Again, suppose } 200 \text{ members in all}$$

$$\text{Then, } \frac{200}{2} + 15 + \frac{200}{3} + 10 = 191 \frac{2}{3} \text{ the members}$$

$$\text{But, } 200 - 191 \frac{2}{3} = 8 \frac{1}{3} \text{ error too much}$$

Errors unlike.

$$\text{Lastly, } \frac{200 \times 8 \frac{1}{6} + 100 \times 8 \frac{1}{3}}{8 \frac{1}{6} + 8 \frac{1}{3}} = \frac{200 + 100}{1 + 1} = \frac{300}{2} = 150$$

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31. $360 \text{ deg.} \times 69\frac{1}{2} \text{ miles} = 25020 \text{ miles round the earth}$
 Then, as $20 \text{ miles} : 1 \text{ day} :: 25020 : 25020 \div 20 = 1251 \text{ days}$
 Lastly, $1251 \text{ days} \div 365\frac{1}{4} \text{ days} = 3 \text{ years } 155\frac{1}{4} \text{ days}$

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32. $100 \times 3\frac{1}{4} = 325$
 $150 \times 4\frac{1}{2} = 675$
 $204 \times 5\frac{3}{4} = 1173$

 $454 \quad) 2173 (4 \text{ months } 23\frac{1}{2} \frac{3}{4} \text{ days}$

da. w. da. w.

33. As $7 : 1 :: 1 : \frac{1}{7}$ A can do alone in one day
 And, as $12 : 1 :: 1 : \frac{1}{12}$ the part B can do in a day
 Then, $\frac{1}{7} + \frac{1}{12} = \frac{12+7}{84} = \frac{19}{84}$ the part of the work that they can
 do in a day, working together
 Lastly, as $\frac{19}{84} \text{ work} : 1 \text{ day} :: 1 \text{ work} : \frac{84}{19} = 4\frac{8}{19} \text{ days}$

34. $\frac{(1,05^7 - 1) \times 400^*}{1,05 - 1} = \frac{,40710042265625 \times 400}{,05}$
 $= 3256,80338125 = 3256 \text{ dollars } 80 \text{ cents } 3 \text{ mills}$

Or thus, by the Table, page 86.

$$\begin{aligned} 1.34009 \times 400 &= 536.036 \\ 1.27628 \times 400 &= 510.512 \\ 1.21550 \times 400 &= 486.200 \\ 1.15762 \times 400 &= 463.048 \\ 1.10250 \times 400 &= 441.000 \\ 1.05000 \times 400 &= 400.000 \end{aligned}$$

\$3256.796*mo. dolls. mo. d.*

35. As $12 : 5 :: 4 : 1\frac{2}{3}$ and $100 + 1\frac{2}{3} = 101\frac{2}{3}$ Then,
 As $3\frac{5}{8} (= 101\frac{2}{3}) : 100 :: 700 : \frac{100 \times 700 \times 3}{305} = 688 \text{ } 52 \text{ } 4\frac{3}{8} \frac{6}{1}$

*RULE. $A = \frac{(Rt-1) \times u}{R-1}$. Here u = the annuity R =

the ratio or amount of £.1, or \$1, in one year as in compound interest;
 t = the time for which the annuity is in arrear. A = the amount of annuity at the end of t years.

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$$36. \quad \frac{3}{8} + \frac{3}{7} = \frac{21+24}{56} = \frac{45}{56} \text{ and } 1 - \frac{45}{56} = \frac{11}{56} \text{ C's parts}$$

$$\text{Then, as } \frac{11}{56} : 140 :: \frac{3}{8} : \frac{\cancel{56}^7 \times 140 \times 3}{11 \times \cancel{8}} = \frac{2940}{11} = 267 \text{ d. } 27 \frac{3}{11} \text{ c.} \quad \text{A paid}$$

$$\text{And, as } \frac{11}{56} : 140 :: \frac{3}{7} : \frac{\cancel{56}^8 \times 140 \times 3}{11 \times \cancel{7}} = \frac{3360}{11} = 305 \text{ } 45 \frac{5}{11} \text{ cts. B paid}$$

37. Suppose the number to be 12.

Then, $12 \times 4 + 16 = 64$ his money

And, $12 \times 6 - 12 = 60$ his money

4 error too little

Again, Suppose 20 to be the number of beggars

Then, $20 \times 4 + 16 = 96$ his money

And $20 \times 6 - 12 = 108$ his money

12 error too much

Errors unlike.

$$\text{Then, } \frac{12 \times 12 + 20 \times 4}{12 + 4} = \frac{224}{16} = 14 \text{ beggars}$$

38. As $18 : 1 :: 1 : \frac{1}{18}$ the part B and C can do in a day working together.

And, as $11 : 1 :: 1 : \frac{1}{11}$ the part of the work they can do in a day, all working

Now, $\frac{1}{11} - \frac{1}{18} = \frac{18-11}{198} = \frac{7}{198}$ the part of the work that A can do in a day

Lastly, as $\frac{7}{198} : 1 :: 1 : \frac{198}{7} = 28 \text{ days } 3 \text{ hrs. } 25 \frac{5}{7} \text{ min.}$

39. Suppose that one dollar was the sum paid by 4 members of Congress—or 5 merchants—or 8 lawyers—or 12 citizens.

doll. doll.

Then, As $4 : 1 :: 20 : 5$

$5 : 1 :: 30 : 6$

$8 : 1 :: 24 : 3$

$12 : 1 :: 24 : 2$

\$16

viz: 16 dolls. would then be the whole bill.

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Question 39 continued.

	dolls.	dolls.	{	5 : 60	paid by the	congress
Next, As	16	: 192 ::		6 : 72	'	merchants
				3 : 36	'	lawyers
				2 : 24	'	citizens

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$$40. \quad 28 \times 20 = 560 \text{ square inches}$$

$$14 \times 10 \times 2 = 280 \quad ' \quad '$$

$$280 = 1\frac{3}{4} \text{ acres}$$

$$41. \quad 200 \text{ acres} = 32000 \text{ perches} = b$$

40 perches = a . The rule is,*
 $\sqrt{\left(\frac{a}{4}\right)^2 + b} - \frac{a}{2}$ the short side, and $\sqrt{\left(\frac{a}{4}\right)^2 + b} + \frac{a}{2}$ the long side
Thus, $\sqrt{\left(\frac{40}{4}\right)^2 + 32000} - \frac{40}{2} = 160$ the short sideAnd $\sqrt{\left(\frac{40}{4}\right)^2 + 32000} + \frac{40}{2} = 200$ the longer side

42. Suppose the side of the square meadow to be 1;

Then, $\sqrt{1^2 + 1^2} = \sqrt{2} = 1,4142136$ its diagonalAnd, $1,4142136 - 1 = ,4142136$ what the diagonal is more than the sideNow say, as $,4142136 : 1 :: 20 : 48,28426$ the side of the required square in perches. Lastly, square the side, and we get the contents 2331,37 perches = 14a. 2r. 11p.†*Solution by Algebra.** Let x = the short side, a = the difference of the sides, and b = the contents in perchesThen, $(x+a) \times x$ = the contents of the ground in perches.That is, $x^2 + ax = b$ by the question. — By completing the square we get $x^2 + ax + \frac{a^2}{4} = \frac{a^2}{4} + b$; and by evolution $x + \frac{a}{2} = \sqrt{\frac{a^2}{4} + b}$, consequently $x = \sqrt{\frac{a^2}{4} + b} - \frac{a}{2}$ † Put x = the side of the square, and $a = 20$:Then, (Euclid 1. 47) $2x^2 = (x+a)^2 = x^2 + 2ax + a^2$ by transposition we get $x^2 - 2ax = a^2$ and by completing the square $x^2 - 2ax + a^2 = 2a^2$, by evolution $x - a = \sqrt{2a^2}$ hence $x = a + a\sqrt{2}$. Now by restoring the value of a we get x the side of the square to be $20 + 20\sqrt{2} = 20 + 20 \times 1,4142136 = 48,284272$ perches in the side the same as above, whence the contents may be readily found.

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43. As $\overset{d.}{18} : \overset{ft.}{1} :: \overset{pence}{24000} (=100) : \overset{L.}{24000} = 4000 \text{ square ft.}$

And, $4000 \div \frac{88}{2} = 4000 \times \frac{1}{44} = 1000 \text{ feet perpendicular}$

Then, $\sqrt{\{44^2 + (\frac{1000}{33})^2\}} = \frac{1}{33} \sqrt{(44^2 \times 33^2 + 1000^2)} = \frac{4}{3} \sqrt{(11^2 \times 33^2 + 250^2)} = \frac{4}{3} \sqrt{194269}$ one of the equal sides; consequently $\frac{8}{3} \sqrt{194269} = 106,85 \text{ \&c. the sum required.}$

Or, decimally

As, $18 : 1 :: 24000 : 1333,33 \text{ \&c. square feet}$

And, $\frac{1333,33}{44} = 30,303 \text{ \&c. the perpendicular}$

Then, $2 \sqrt{44^2 + 30,303^2} = 2 \sqrt{2854,27} = 106,85 \text{ feet}$

44. Half an acre $80 \text{ per.} \times 30\frac{1}{4} = 2420 \text{ square yards}$

Then, $\frac{2420}{7854} = 3081,23 \text{ the square of the diameter.}$

Lastly, $\frac{\sqrt{3081,23}}{2} = \frac{55,5}{2} = 27,75 \text{ yards}$

45. $114 \text{ yards } 6 \text{ feet} = 1032 \text{ square feet}$

Then, $1032 \div 28 = 36\frac{6}{7} \text{ feet}$

46. $\frac{7 \times 2\frac{1}{2} \times 2}{3} = \frac{35}{3} = 11\frac{2}{3} \text{ inches}$

47. $20 \text{ feet} = 240 \text{ inches}$

And, $240 \times 1\frac{1}{4} \times 1\frac{1}{4} = 240 \times \frac{5}{4} \times \frac{5}{4} = 600 \text{ cubic inches}$

Half a ton is 1120 pounds; also, $50 \text{ feet} = 600 \text{ inches}$

And, $600 \times \frac{7}{8} \times \frac{7}{8} = 2940 \text{ cubic inches}$

Then, as $\overset{\text{cubic in.}}{375} : \overset{\text{lb.}}{1120} :: \overset{\text{cubic in.}}{459\frac{3}{8}} : \overset{\text{lb.}}{1372}$

Lastly, as $\overset{\text{lb.}}{1} : \overset{\text{d.}}{3\frac{1}{2}} :: \overset{\text{lb.}}{1372} : \overset{\text{pence}}{4802} = \overset{\text{L. s. d.}}{20 \ 0 \ 2}$

48. Here $\sqrt{39^2 - 15^2} = \sqrt{1521 - 225} = \sqrt{1296} =$

36 feet standing

Then, $36 + 39 = 75 \text{ feet the whole height}$

49. Here work backwards

Thus, $24 \times 9 = 216$; $\sqrt[3]{216} = 6$; $6 \times \frac{4}{3} = 8$; $8^2 = 64$; $64 - 4 = 60$; $60 \div 5 = 12$; $12 \times 8 = 96$; lastly, $96 + 7 = 103$.

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50. First, because that $\frac{1}{10}$ of the whole contents was drawn out each time, consequently $\frac{1}{10}$ of the parts was drawn.

Hence, 500 gallons of wine

$$\frac{1}{10} = 50 \text{ subtract}$$

$$\underline{\quad\quad} 450$$

$$\frac{1}{10} = 45$$

$$\underline{\quad\quad} 405$$

$$\frac{1}{10} = 40\frac{1}{2}$$

$$\underline{\quad\quad} 364\frac{1}{2}$$

$$\frac{1}{10} = 36\frac{9}{20}$$

$$\underline{\quad\quad} 328\frac{1}{20}$$

$$\frac{1}{10} = 32\frac{16}{200}$$

$$\underline{\quad\quad} 295\frac{49}{200} \text{ galls. wine}$$

And, $500 - 295\frac{49}{200}$ galls. water

Or thus,

Here the several portions of wine drawn off were

50, remains 450

$$\frac{50 \times 450}{500} \text{ remains } 450 - \frac{50 \times 450}{500} = \frac{450^2}{500}$$

$$\frac{50 \times 450^2}{500^2} \text{ remains } \frac{450^2}{500} - \frac{50 \times 450^2}{500^2} = \frac{450^3}{500^2}$$

$$\frac{50 \times 450^3}{500^3} \text{ remains } \frac{450^3}{500^2} - \frac{50 \times 450^3}{500^3} = \frac{450^4}{500^3}$$

$$\frac{50 \times 450^4}{500^4} \text{ remains } \frac{450^4}{500^3} - \frac{50 \times 450^4}{500^4} = \frac{450^5}{500^4}$$

$$\text{Therefore, } \frac{450^5}{500^4} = \frac{18452812500000}{62500000000} = 295\frac{49}{200} \text{ gallons of wine}$$

$$\text{Consequently, } 500 - 295\frac{49}{200} = 204\frac{151}{200} \text{ galls. of water}^*$$

* *Analytically.* Put $500=c$, $50=d$, $5=t$, and x =what wine remains after drawing t times

Then, $c-d$ expresses the quantity of wine left after the first drawing; $c : c-d :: d : \frac{(c-d) \times d}{c}$ the quantity of wine drawn out at the second drawing, and $c-d - \frac{(c-d) \times d}{c} = \frac{(c-d)^2}{c}$ the quantity of wine left after the second drawing.

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$$51. \quad \frac{2 \times 2 \times 4}{4 \times 4 \times 8} = \frac{16}{128} = \frac{1}{8} \text{ part}$$

52. 1817, April 1st. principal 1864 dollars
 Oct. 15th 1864 doll. mult. by 197 days = 367208
 Paid 225,50

1818 Jan. 10th 1638,50 × 87 = 142549,5
 Paid 188,86

May 16th 1449,64 × 126 = 182654,64
 Paid 585

Aug. 1st. 864,64 × 77 = 66577,28
 Interest 126,49

6|0)75898|9,42

Balance \$991,13

Interest \$126,49

$$53. \quad \frac{36 \times 6\frac{1}{2} \times 8\frac{3}{4}}{128} = \frac{2047\frac{1}{2}}{128} = 15\frac{2\frac{5}{6}}{56} \text{ cords}$$

Continuation of Note on p. 134.

Also, $c : \frac{(c-d)^2}{c} :: d : \frac{(c-d) \times d}{c^2}$ the quantity of wine drawn out at the third drawing.

And, $\frac{(c-d)^2}{c} - \frac{(c-d)^2 \times d}{c^2} = \frac{(c-d)^3}{c^2}$ = the quantity of wine left after the third drawing; and universally—

$c : \frac{(c-d)^{t-1}}{c} :: d : \frac{(c-d)^{t-1} \times d}{c}$ = the quantity of wine drawn out at the t drawing.

And, $\frac{c-d}{c} - \frac{(c-d)^{t-1}}{c} = \frac{(c-d)^t}{c}$ = x = the quantity of wine remaining after the t drawing. By substituting the values of c , d , and t , in this formula, we get

$$\frac{(500-50)^5}{500^4} = \frac{450^5}{500^4} = 295\frac{49}{200} \text{ galls. of wine the same as above}$$

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$$54. \text{ As } \begin{matrix} \text{days} & \text{dolls.} & \text{cts.} & \text{day} \\ 365 & : & 356 & 34 \end{matrix} :: 1 : 97 \text{ cents } 6\frac{2}{3} \text{ mills}$$

$$55. \text{ As } \begin{matrix} \text{cts.} & \text{doll.} & \text{dolls.} & \text{cts.} & \text{dolls.} & \text{cts.} \\ 18\frac{3}{4} & : & 1 & :: & 2564 & 95\frac{1}{2} \end{matrix} : 13679 \text{ } 76$$

$$56. \text{ Inverse } \begin{matrix} 8 \text{ men} \\ \$20,50 \end{matrix} \left. \vphantom{\begin{matrix} 8 \text{ men} \\ \$20,50 \end{matrix}} \right\} \begin{matrix} \text{days} \\ 30 \end{matrix} \left\{ \begin{matrix} 64 \text{ men inverse} \\ 100 \text{ dollars} \end{matrix} \right.$$

$$\text{Then, } \frac{30 \times \cancel{8} \times \cancel{100} \cancel{00} \cancel{00} \cancel{00}}{\cancel{64} \times \cancel{20} \cancel{50}} = \frac{30 \times 25}{41} = 18\frac{1}{41} \text{ days}$$

$$57. \text{ Inverse } \begin{matrix} 34 \text{ men} \\ 1 \text{ bridge} \end{matrix} \left. \vphantom{\begin{matrix} 34 \text{ men} \\ 1 \text{ bridge} \end{matrix}} \right\} \begin{matrix} \text{months} \\ 6 \end{matrix} \left\{ \begin{matrix} 86 \text{ men inverse} \\ 2 \text{ bridge} \end{matrix} \right.$$

$$\text{Then, } \frac{6 \times 34 \times 2}{86 \times 1} = \frac{204}{43} = 4\frac{2}{43} \text{ months}$$

58. As $4 : 6 :: 7 : 10\frac{1}{2} = 10,5$ dollars C must pay when A pays 5 dollars and B 7 dollars.

$$\text{And, } 5 + 7 + 10\frac{1}{2} = 22\frac{1}{2} = 22,5 \text{ dollars}$$

$$\text{Lastly, as } \begin{matrix} \text{dolls.} & \text{dolls.} \\ 22,5 & : & 240 \end{matrix} :: \left\{ \begin{matrix} 5 : \$ 53 \text{ } 33\frac{1}{2} & \text{A receives} \\ 7 : \$ 74 \text{ } 66\frac{2}{3} & \text{B} \\ 105, : \$ 112 \text{ } 00 & \text{C} \end{matrix} \right.$$

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$$59. \text{ As } \begin{matrix} \text{dolls.} & \text{cts.} & \text{ms.} & \text{dolls.} & \text{cts.} & \text{dolls.} & \text{cts.} \\ 100 & : & 7 & 3 & :: & 8564 & 20 : 6 \end{matrix} 25 + \text{tax}$$

60. (4 galls. 2 qt.)—(2 galls. 2 qt. 1 pt.)=1 gall. 3 qt. 1 pt.=15 pints gained, or remaining in the vessel at the end of one hour.

And, $84\frac{1}{2}$ gallons is 676 pints

$$\text{Then, as } 15 \text{ pts.} : 1 \text{ hr.} :: 676 \text{ pints} : 45 \text{ hours } 4 \text{ minutes}$$

$$61. \text{ One acre } \begin{matrix} \text{P.} & \text{ft.} & \text{ft.} \\ 160 & \times & 16,5 \end{matrix} \times \begin{matrix} \text{ft.} \\ 16,5 \end{matrix} = 160 \times 272\frac{1}{4} = 43560 \text{ } \begin{matrix} \text{sq. feet} \end{matrix}$$

$$\text{Then, } 43560 \div 36 = 1210 \text{ feet} = 73\frac{1}{4} \text{ perches}$$

$$62. \begin{matrix} 50 \text{ men} \\ 30 \text{ days} \end{matrix} \left. \vphantom{\begin{matrix} 50 \text{ men} \\ 30 \text{ days} \end{matrix}} \right\} \begin{matrix} \text{bushels} \\ 12 \end{matrix} \left\{ \begin{matrix} 40 \text{ men} \\ 90 \text{ days} \end{matrix} \right.$$

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Question 62 continued.

$$\text{Then, } \frac{12 \times 40 \times \cancel{p\phi}}{50 \times \cancel{p\phi}} \times \frac{12 \times 4 \times 3}{5} = \frac{144}{5} = 28\frac{4}{5} \text{ bushels}$$

63. Suppose

$$\text{Boy } 1 \times 6 = 6 \text{ cents}$$

$$\text{Women } 3 \times 8 = 24 \text{ '}$$

$$\text{Men } 6 \times 16 = 96 \text{ '}$$

126 cents

$$\text{Then, as } 126 : 1890 :: \left\{ \begin{array}{l} 6 : 90 \text{ cents the boys get} \\ 24 : 360 \text{ cents the women get} \\ 96 : 1440 \text{ cents the men get} \end{array} \right.$$

$$\text{Consequently, } 90 \div 6 = 15 \text{ boys}$$

$$360 \div 8 = 45 \text{ women}$$

$$\text{And } 1440 \div 16 = 90 \text{ men}$$

$$64. \quad 7 \times 4\frac{1}{2} - 8 \times 3 = 31\frac{1}{2} - 24 = 7\frac{1}{2} \text{ miles apart in one day}$$

$$\text{Then, as } 1 \text{ day} : 7\frac{1}{2} \text{ mi.} :: 13 \text{ days} : 97\frac{1}{2} \text{ miles apart}$$

$$65. \quad 962 \times 6 = 5772$$

$$320$$

$$1282 \times 6 = 7692$$

$$\text{A } 13464$$

$$\text{A } 13464$$

$$\text{B } 11853,75$$

$$25317,75 \quad \text{Then,}$$

dolls. cts. ms.

$$\text{As } 25317,75 : 486 \text{ } 64 :: \left\{ \begin{array}{l} 13464 : 258,79,5\frac{18465}{33757} \\ 11853,75 : 227,84,4\frac{15292}{33757} \end{array} \right.$$

Proof \$486,64

$$66. \quad \text{Here } \frac{5280^3 \times 2^3}{2500 \times 6 \times 5280 \times 3} =$$

$$44$$

$$352$$

$$\cancel{p\phi}4$$

$$\cancel{1}\phi\cancel{p\phi}$$

$$\cancel{p\phi}\cancel{p\phi} \times \cancel{p\phi}\cancel{p\phi} \times \cancel{p\phi}\cancel{p\phi} \times 8 = 44 \times 352 \times 8 = 123904$$

$$\frac{\cancel{p\phi}\cancel{p\phi} \times \cancel{p\phi} \times \cancel{p\phi}\cancel{p\phi} \times \cancel{p}}{25} = \frac{25}{25} = 25$$

$$\cancel{1}\phi\cancel{p}$$

$$25$$

$$= 4956\frac{4}{5} \text{ hours} = 206 \text{ days } 12 \text{ hours } 9 \text{ min. } 36 \text{ seconds}$$

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67. $45\frac{1}{2}$ ft.— $9\frac{1}{2}$ in.=546 in.— $9\frac{1}{2}$ in.=536 $\frac{1}{2}$ inchesAnd $9\frac{1}{2}$ in.— $6\frac{3}{4}$ in.= $2\frac{1}{4}$ inches gained in a dayNow, $536\frac{1}{2} \div 2\frac{1}{4} = \frac{1073}{2} \times \frac{4}{11} = 2\frac{146}{11} = 195\frac{1}{11}$ daysThat is, it will be within $9\frac{1}{2}$ inches of the top in $195\frac{1}{11}$ days.
Consequently it will get to the top in $196\frac{1}{11}$ days.

$$68. \quad \frac{1}{2} + \frac{1}{5} + \frac{1}{8} + \frac{1}{9} = \frac{180 + 72 + 45 + 40}{360} = \frac{337}{360}$$

$$\text{And } 1 - \frac{337}{360} = \frac{23}{360} \text{ Then,}$$

$$\text{As } \frac{23}{360} : 46 :: 1 : \frac{46 \times 360}{23} = 720 \text{ trees}$$

69. Suppose 200 dolls. Again, Suppose 300 dollars

94

94

106

206

 $\frac{1}{2}$ of 106 = 53 lent $\frac{1}{2}$ of 206 = 103 lent $\frac{1}{5}$ of 106 = $21\frac{1}{5}$ clothes $\frac{1}{5}$ of 206 = $41\frac{1}{5}$ clothes

94 debts

94 debts

\$168 $\frac{1}{5}$ sum gone\$238 $\frac{1}{5}$ sum gone $\frac{9}{10}$ of 200 = 180 $\frac{9}{10}$ of 300 = 27011 $\frac{4}{5}$ error too mucherror 31 $\frac{4}{5}$ too much

Errors alike.

$$\text{Then, } \frac{200 \times 31\frac{4}{5} - 300 \times 11\frac{4}{5}}{31\frac{4}{5} - 11\frac{4}{5}} = \frac{6360 - 3540}{20} = 141 \text{ dolls.}$$

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$$70. \quad \frac{1}{2} - \frac{1}{4} = \frac{4 - 3}{12} = \frac{1}{12}$$

Then, as $\frac{1}{12} : 84 :: 1 : 84 \times 12 = 1008$ 71. Here $3 - 2 : 4$ ft. $:: 3 : 12$ feet the semidiameter of the circle that the outer wheel makes. Consequently $12 \times 2 = 24$ feet the diameter of the outer circle.And, $24 - 4 \times 2 = 16$ feet the diameter of the inner circleLastly, $24 \times 3,1416 = 75,3984$ feet by the outer wheelAnd, $16 \times 3,1416 = 50,2656$ feet by the inner wheel

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72. Here* $1\frac{2}{3}$ = one of the equal sides, $1\frac{2}{3}$ = half the sum of the sides

$$\text{And } 1\frac{2}{3} - 1\frac{2}{3} = \frac{375 - 250}{6} = 1\frac{2}{3} \text{ one of the equal rem.}$$

$$\text{Then, } \sqrt{1\frac{2}{3} \times 1\frac{2}{3} \times 1\frac{2}{3} \times 1\frac{2}{3}} = \frac{125^2}{6} \sqrt{1\frac{1}{2}} = \frac{125^2}{6} \times \frac{1}{2} \sqrt{3} =$$

$$\frac{125^2}{6^2} \sqrt{3} = \frac{15625}{36} \sqrt{3} = \frac{15625 \times 1,7320508}{36} =$$

751,75816 square feet.

Or, by RULE II, thus; $125 \div 3 = 1\frac{2}{3}$ is one of the equal sides of the triangle, and because the triangle is equilateral, and consequently equiangular, the included angle of any two sides is 60° , whose natural sine is ,8660254

$$\text{Hence, } 1\frac{2}{3} \times 1\frac{2}{3} \times ,8660254 = 751,7581596 \text{ square feet}$$

* Here data is given to find the sides.

The rule for solving this question, and all of a similar kind, is by mensuration, as follows:

1. From half the sum of three sides subtract each side severally.
2. Multiply the half sum and the three remainders continually together, and the square root of the product will be the area required.

RULE II. Any two sides of a triangle being multiplied together, and the product again by half the natural sine of their included angle, will give the area of the triangle.

That is, $AC \times CB \times \text{natural sine of the angle } C = \text{twice area.}$



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